Homework 3

Due date: 2023/12/09 23:59pm

1. (25%) True or false?
   a. (5%) 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. (5%) 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. (5%) With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
   d. (5%) The `Date:` header in the HTTP response message indicates when the object in the response was last modified.
   e. (5%) HTTP response messages never have an empty message body.

2. (20%)
   a. (6%) How does SMTP mark the end of a message body?
   b. (6%) How about HTTP?
   c. (8%) Can HTTP use the same method as SMTP to mark the end of a message body? Explain.

3. (20%) 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, …, 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?

4. (20%) Suppose Bob joins a BitTorrent torrent, but he does not want to upload any data to any other peers (so called free-riding).
   a. (10%) Bob claims that he can receive a complete copy of the file that is shared by the swarm. Is Bob's claim possible? Why or why not?
   b. (10%) Bob further claims that he can further make his "free-riding" more efficient by using a collection of multiple computers (with distinct IP addresses) in the computer lab in his department. How can he do that?

5. (15%) Assume you request a webpage consisting of one document and five images. The document size is 1 kbyte, all images have the same size of 50 kbytes, the download rate is 1 Mbps, and the RTT is 100 ms. How long does it take to obtain the whole webpage under the following conditions? (Assume no DNSname query is needed and the impact of the request line and the headers in the HTTP messages is negligible).
   a. (5%)Nonpersistent HTTP with serial connections.
   b. (5%)Nonpersistent HTTP with two parallel connections.
   c. (5%)Persistent HTTP with one connection.