# Assignment 2: Network Applications

1. (1 point) What is the difference between network architecture and application architecture?

2. (1 point) For a communication session between a pair of processes, which process is the client and which is the server?

3. (1 point) In BitTorrent, suppose Alice provides chunks to Bob throughout a 30-second interval. Will Bob necessarily return the favor and provide chunks to Alice in this same interval? Why or why not?

4. (2 points) 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. With non-persistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.

   c. The `Date:` header in the HTTP response message indicates when the object in the response was last modified.

   d. HTTP response messages never have an empty message body.

5. (2 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). The characters <cr><lf>are carriage return and line-feed characters (that is, the italic 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?

6. (3 points) Consider distributing a file of $F$ = 20 GB to $N$ peers. The server has an upload rate of $u_s$ = 1 Gbps, and each peer has a download rate of $d_i$ = 20 Mbps and an upload rate of $u_i$. For $N$ = 10, $N$ = 100, or $N$ = 1000, and $u_i$ = 500 kbps, $u_i$ = 5 Mbps, or $u_i$ = 25 Mbps, prepare a table giving the minimum distribution time for each of the combinations of $N$ and $u_i$ for both client-server distribution and P2P distribution. For simplicity, round your results for the minimum distribution time into integers in terms of seconds.

**Minimum distribution time for client / server:**

| $u_i$ (Mbps) | $N$ = 10 | $N$ = 100 | $N$ = 1000 |
|---|---|---|---|
| 0.5 | | | |
| 5 | | | |
| 25 | | | |

**Minimum distribution time for peer-to-peer:**

| $u_i$ (Mbps) | $N$ = 10 | $N$ = 100 | $N$ = 1000 |
|---|---|---|---|
| 0.5 | | | |
| 5 | | | |
| 25 | | | |

## Appendix

Table of Units for Data Size.

| Unit | Abbreviation | Value |
|---|---|---|
| kilobyte | KB | $10^3$ bytes |
| megabyte | MB | $10^6$ bytes |
| gigabyte | GB | $10^9$ bytes |
| terabyte | TB | $10^{12}$ bytes |

Table of Units for Data Rate.

| Unit | Abbreviation | Value |
|---|---|---|
| kilobits/s | kbps, kbit/s | $10^3$ bits/s |
| megabits/s | Mbps, Mbit/s | $10^6$ bits/s |
| gigabits/s | Gbps, Gbit/s | $10^9$ bits/s |