SYSC 5201 Fall 2012 Assignment #2

1.

Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time. (See the discussion of statistical multiplexing in Section 1.3.)

a. When circuit switching is used, how many users can be supported?

b. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

c. Suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (*Hint*: Use the binomial distribution.)

d. Find the probability that there are 21 or more users transmitting simultaneously. (Hint: Use Central Limit Theorem to estimate the final number.)

2.

Obtain the HTTP/1.1 specification (RFC 2616). Answer the following questions:

a. Explain the mechanism used for signaling between the client and server to indicate that a persistent connection is being closed. Can the client, the server, or both signal the close of a connection?

b. What encryption services are provided by HTTP?

c. Can a client open three or more simultaneous connections with a given server?

d. Either a server or a client may close a transport connection between them if either one detects the connection has been idle for some time. Is it possible that one side starts closing a connection while the other side is transmitting data via this connection? Explain.

3.

Suppose you can access the caches in the local DNS servers of your department. Can you propose a way to roughly determine the Web servers (outside your department) that are most popular among the users in your department? Explain.

4.

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.

a. Suppose that $u_s \leq (u_s + u_1 + \ldots + u_N)/N$. Specify a distribution scheme that has a distribution time of F/u_s.

b. Suppose that $u_s \geq (u_s + u_1 + \ldots + u_N)/N$. Specify a distribution scheme that has a distribution time of $NF/(u_s + u_1 + \ldots + u_N)$.

c. Conclude that the minimum distribution time is in general given by $\max\{F/u_s, NF/(u_s + u_1 + \ldots + u_N)\}$.

5.

In the circular DHT example in Section 2.6.2, suppose that a new peer 6 wants to join the DHT and peer 6 initially only knows peer 15's IP address. What steps are taken? (See Slide 72 in Chapter 2)

6.

In this problem, we are interested in finding out the efficiency of a BitTorrent-like P2P file sharing system. Consider two peers Bob and Alice. They join a torrent with M peers in total (including Bob and Alice) that are sharing a file consisting of N chunks. Assume that at a particular time t, the chunks that a peer has are uniformly at random chosen from all N chunks, and no peer has all N chunks. Answer the following questions.

a. What is the probability that Bob has all the chunks that Alice has, given that the numbers of chunks that Bob and Alice have are denoted by n_b and n_a?
b. Remove part of the conditioning in part a) to find out the probability that Bob has all the chunks that Alice has, given that Alice has n_a chunks?
c. Suppose that each peer in BitTorrent has 5 neighbors. What is the probability that Bob has data that is of interest to at least one of his five neighbors?