HW #0

ELEN E6761 - Computer Communication Networks — Due 9/6/2000
Fall 2000 — Prof. Rubenstein

This first homework assignment will not be graded, but should be turned in. Its purpose is to allow me to determine the best pace for the course. You should answer these questions as best you can off the top of your head. If you don't know the answer off the top of your head, but know where you could find the *specifics* of the answer (RFC, textbook, web), put that down instead.

Don't worry if you have trouble answering some or all of the questions.

1. On my netscape browser, I enter in "google.com" and the google web-page appears. Describe the network-related events that occurred (where and when lookups took place, protocols used, etc.)

2. A company has opened a new office in three buildings that are adjacent to one another, and wishes to establish network connectivity with the Internet. How should these buildings be wired and connected?

3. A file needs to be transferred reliably (i.e., no data loss) at a rate of 50 Kbs. The code has already been written such that the data is pumped into a socket at a rate of 50 Kbs. What problems can arise if the socket uses

   (a) TCP (socket protocol option SOCK_STREAM)?

   (b) UDP (socket protocol option SOCK_DGRAM)?

4. Consider a set of IP routers that use the same routing protocol.

   (a) Give the name of a routing protocol.

   (b) Describe in general how routes are computed (in enough detail that it distinguishes the protocol from other possible routing protocols).

   (c) What state does an IP router maintain in order to forward an IP packet toward its destination (assume classless routing [CIDR])?

   (d) A packet may traverse a path whose route contains routers running different routing protocols. How is this accomplished within the Internet?

5. A sender, s, wishes to deliver a packet to $n+1$ receivers. It transmits the packet to a specially designated receiver, r_0, which then transmits the packet to each of the remaining n receivers, $r_1, \cdots, r_n$. The packet transmission from s to r_0 is successful with probability p_0. Transmission from r_0 to any $r_i, 1 \leq i \leq n$ is independently successful with probability p_1. Let $X_i, 0 \leq i \leq n$, be a random variable that equals 1 if r_i receives the packet, and equals 0 if r_i does not. Let $S = \sum_{i=0}^{n} X_i$. Calculate

   (a) $\Pr(X_1 = 1)$

   (b) $E[S]$

   (c) $\Pr(S = k)$ for $k < n + 1$

   (d) $\Pr(X_1 = 1 | X_0 = 1)$

   (e) $\Pr(X_1 = 1 | X_2 = 0)$

6. A sender, s, wishes to deliver m packets to a set of n receivers labeled $r_1, \cdots, r_n$ over a series of m rounds. Packet $j, 1 \leq j \leq m$ is sent to (but not necessarily received by) all receivers in the jth round. The transmission of any packet from s to any r_i is independently successful with probability p. Let R_j be a random variable that equals the number of rounds that must be performed so that all receivers receive *at least* j packets. Calculate

   (a) $\Pr(R_j = j)$ for $1 \leq j \leq m$

(b) $\Pr(R_1 > i)$ for $1 \leq i \leq m$

(c) $E[R_1]$ (express as a sum)

(d) $\Pr(R_j > j + 2)$ for $1 \leq j \leq m - 2$.

7. Station A transmits data on a communication channel in bursts. Let T_i be a random variable that equals the start-time of A's ith transmission burst, and let L_i be a random variable that equals the length of time of A's ith transmission. The L_i are exponentially distributed with rate λ_1 (i.e., $\Pr(L_i > t) = e^{-\lambda_1 t}$). After A finishes its ith transmission, it waits a period of time that is exponentially distributed with rate λ_2.

   (a) If $\lambda_1 = \lambda_2$, then what is $\Pr(T_{i+1} - T_i > t)$ (in terms of λ_1 and t)?

   (b) Let x be the fraction of time that the channel is used by A. What is λ_2 in terms of λ_1 and x?

   (c) Let t_1 be the time that A starts transmitting its first burst, and assume we know that at time $t_2 > t_1$, it is still transmitting that burst. What is $\Pr(L_i > t | L_i > t_2 - t_1)$?