

HW #1

COMS W4119 - Computer Networks
Spring 2006

Due Jan 30, 2006
Prof. Rubenstein

Homework must be turned in at the beginning of class on the due date indicated above. CVN students have one additional day. Late assignments will not be accepted.

This first assignment deals with a simple chat application, and how to communicate information. Because different operating systems may store information in different formats, the *packet* must store information in a format that is universal to all machines (i.e., one cannot just dump a `struct` into a packet and send it).

Suppose you are asked to design a stream format for a Chat protocol (e.g., AIM) whose messages will consist of ASCII text (e.g., the e-mail SMTP protocol fits this description). Every time a message is transmitted, the transmission must contain three *components*: the (application layer) name of the sender (i.e., the sender's IM screen name), the (app layer) name of the receiver and the text message to be delivered.

1. Suppose the underlying transport layer guarantees that the information passed to it will be delivered in-order and without loss or corruption to the destination (e.g., the TCP transport layer protocol provides such a medium). Also, assume that both sides are aware of an intentional termination of a connection (initiated at either side). For each part of this question, after giving an explanation of how it is done, give an example of the transmission from sender TOM to receiver JERRY with message OUCH.
 - (a) One way to implement the transmission of these three pieces of information is to use different connections. Explain this procedure, assuming a socket-like interface to the transport layer.
 - (b) Suppose a single connection is used to transmit all information. Assume that the maximum length of a name is 256 bytes and a message is at most 65,536 bytes (length 0 names and messages not permitted). Design a stream format where some bytes are used to describe the lengths of the various components that follow.
 - (c) Assume the same constraints hold as in part (1b), and that in addition, the names and message can only be formed from ASCII characters (i.e., only some byte-values are permissible parts of a message). Describe another way of delimiting the stream into its three components.
 - (d) Suppose the names and message are permitted to contain any byte value. Explain how to extend the format in part (1c) to properly delimit the various components without explicitly stating the lengths of those component.
2. Suppose identifiers are chosen at random by users, where an identifier is a k -byte alpha-numeric string (i.e., each character in the string can be one of 36 possible choices). Assume that any string is equally likely to be chosen as any other,
 - (a) Suppose user A and user B both choose a random k -byte identifier (where each byte can be set to one of 36 different values). What is the likelihood that A and B choose the same identifier (as a function of k)?
 - (b) Suppose there are N users in the system who all choose k -byte identifiers. What is the likelihood that a user A has the same identifier as *at least one* other user (as a function of k and N)?
 - (c) What is the likelihood in (2b) that all users have different identifiers?
 - (d) Suppose that, when two users discover their identifiers collide, one is arbitrarily chosen to randomly choose a new identifier. How big must k be to allow all N users to have distinct identifiers?
 - (e) Suppose variable-length identifiers were permitted from size 1 up to size k . How many users could be supported now? Write your answer without using a summation for full credit.