There are 4 questions; answer all of them. If you need to make an assumption to clarify a problem, write your assumption down. Only reasonable assumptions get full credit. Explain all answers. You have seventy five minutes to finish the exam; and the exam is worth seventyfive points. The questions are of varying difficulty; so it is probably advisable to answer the easier questions first to avoid getting stuck on the harder ones. Good Luck!

1. Name your favourite collaborative infrastructure. (1 pt.)

2. Replicated vs. Centralized (26 pts.)
   (a) Explain, using diagrams and in a layer-independent fashion, the implementation of and difference between the replicated and centralized architecture. (10 pts)

   Given below are several pairs of opposing conditions. For each pair, explain which condition favors the centralized architecture and which favors the replicated architecture, assuming all other factors are constant. For example, for (d), explain if the behavior/performance/implementation effort of replicated or centralized architecture is improved if users enter input serially vs. in parallel. For each of these pairs, pick a single evaluation metric as you may get different answers for different metrics. A metric need not be related to performance.

   (b) Replicated vs. centralized file system. (5 pts.)

   (c) Slow vs. fast connections among users. (5 pts.)

   (d) Serial vs. concurrent input. (Serial input may be guaranteed by floor or social control.) (6 pts.)

3. High vs. Low-level Shared Layer (24 pts.)
   While giving each of the advantages below, be sure to mention if it assumes the centralized or replicated architectures.

   (a) Give two advantages of sharing a low-level layer over a high-level layer. (8 pts.)

   (b) Give four distinct advantages of sharing a high-level layer over a low-level layer. (16 pts.)

   Continued =>
4. Model-based Sharing (24 pts.)

(a) What is a broadcast method? (5 pts.)

(b) Define a class using broadcast methods that implements the model of an Instant Message application showing strings (asynchronously) entered by users in a common history. You do not have to worry about the implementation of the view. Also your class does not have to worry about notifying views - all it has to do is maintain the model state. (8 pts)

(c) Give an advantage of using broadcast methods over remote procedure calls. (4 pts.)

(d) Give two ways in which remote procedures, in comparison to broadcast methods, offer more flexibility in defining collaboration semantics. (7 pts.)