CSci 555 Midterm Exam

Fall 2009

Instructions:

Show all work. No electronic devices are allowed. This exam is open book, open notes. You have 100 minutes to complete the exam.

Please prepare your answers on separate sheets of paper. You may write your answers on the sheet of paper with the question (front and back). If you need more space, please attach a separate sheet of paper to the page with the particular question. Do NOT extend your answer on the back of the sheet for a different question, and do NOT use the same extra sheet of paper to answer more than one question. In particular, each numbered questions must appear on separate pieces of paper so that the exam can be split for grading. If you write part of your answer on the back of a page for another question, then the grader will not see the extra text for your answer and will not consider that part of your answer when assigning a grade.

Be sure to include your name and USC ID number on each page.

There are 100 points in all and 4 questions.

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1. **(30 points) Communication Models**

   In class we discussed several communication models including message passing, distributed shared memory, and remote procedure call. This question will test your understanding of the issues related to these communication models.

   a) **Performance:** Which one of the models discussed is likely to be capable of providing the best performance and why? Why would this reason provide better performance over the other two models? Be sure to state any assumptions you are making. (10 points)

   b) **Synchronization:** Rank the three approaches from strongest support for synchronization to weakest support for synchronization and justify your ranking. By strongest support for synchronization, I mean that the provision of synchronization is closest to automatic, and by weakest support for synchronization I mean that most of the effort for synchronization is left to the programmer using the method. In this question I am asking about synchronization for the application that uses the method, not necessarily the underlying requirements for synchronization needed to implement the method. (10 points)
c) Reliability: Explain what, if anything, the programmer must do to ensure reliability when communicating using each of the three approaches? For each approach, describe the behavior observed by the application when the system experiences a persistent problem that is not repaired or fixed (because of a lengthy network partition or a server failure). (10 points)
2. (25 points) Security

For each of the security mechanisms listed below, briefly explain how the mechanism supports confidentiality, integrity, and authentication. If it does not support one of them, so indicate.

(5 points each)

a) Encryption:

b) Capabilities:

c) Kerberos:
d) Access Control Lists:


e) Virtual Memory:
3. **(15 points) Transactions**

In the two phase commit protocol for transactions what happens if we have a power failure that affects all four servers involved in a transaction and the coordinator (a 5th server)? More specifically, describe the results upon system restart and completion of recovery (either Committed, Aborted, or inconsistent) when the power failure occurs at the following times. If inconsistent, indicate which servers think the result is “commit”, and which think the result is “abort”:

a) After 3 servers have sent “Yes”, to the “prepared to commit query” and the 4th server had not yet responded? (5 points)

b) The coordinator sent “Do commit”, and the “Do Commit” was received by 2 of the servers, but not the other two. (5 points)

c) All servers received the “Do Commit” query, but none responded “Have committed”. (5 points)
4. **(30 points) Design problem**

You are designing a new naming system for internet media objects (pictures, movies, sound, etc). Your goal is to enable better caching of data, and in particular to enable use of multi-level caching of the content itself in much the same way that multi-level caching is supported for names in the domain name system.

   a. Right now, hypertext links in documents use URL’s, which specify a particular location for a document. If you could change this, suggest what information would be used in the hypertext links of new documents, how such information would be used, and the advantages and drawbacks to your changes. (10 points)

   b. What changes would you make to web servers, and in particular web proxies, to take better advantage of your new approach to naming? (10 points)
c. What are some of the security issues associated with your change? Some of these issues parallel problems that exist in the domain name system. Suggest some solutions to address these security issues. (10 points)