

Part I

This part covers the same material as the midterm exam.

- 1a Explain the principle of a page-based distributed shared memory (DSM) system. 5pt
- 1b Consider a distributed operating system that supports memory-mapped files. Outline an implementation for a DSM system using files instead of pages. 10pt
- 1c In either a page-based or file-based DSM system, what do you consider as the major common scalability problem. Explain your answer. 5pt

- 2a Give a simple solution for synchronizing clocks in a local-area distributed system. 5pt
- 2b Explain how Lamport timestamps work, and what they achieve. 5pt
- 2c Consider a group of three communicating processes using vector timestamps. If process P_1 receives a message m with timestamp $[3, 2, 4]$ from process P_3 , what does this mean? When will P_1 deliver m if it is required to maintain causality? 5pt
- 2d Suppose a process P_i timestamps its messages with a matrix M_i , where $M_i[j, k] = n$ indicates that P_i knows that P_j has received n messages from P_k . Give an application of such a timestamp. 10pt

Part II

- 3a Explain the principle of anti-entropy as used in epidemic protocols. 5pt
- 3b What is the problem with removing data in epidemic protocols, and how can it be solved? 5pt
- 3c For an electronic bulletin board, explain how Write-Follows-Read consistency guarantees that you never see a response before the original posting. 5pt

- 4a Large-scale reliable multicasting introduces a feedback problem. Give a solution and discuss that solution's main advantages and disadvantages. 10pt
- 4b What is meant by a virtually synchronous reliable muticast? 5pt

- 5a Consider a distributed system that supports only synchronous method invocations to remote objects. Outline the implementation of a client-side-only extension that will allow a client to perform CORBA's deferred synchronous invocations. 10pt
- 5b DCOM uses only local interface pointers as references to remote objects. Explain how object references are passed between different processes in such a system. 5pt

Final grade: (1) Add, per part, the total points. (2) Let T denote the total points for the midterm exam ($0 \leq T \leq 45$); $D1$ the total points for part I; $D2$ the total points for part II. The final number of points E is equal to $\max\{T, D1\} + D2 + 10$.