

Exam in Distributed Systems

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March 2013

Cover Sheet

This sheet should be handed in together with the exam.

Each problem must be solved on a separate sheet. Write your name on each sheet. Indicate below which questions you have answered.

Problem no.	Solution provided	Max	Your points
1		16	
2		7	
3		14	
4		14	
5		8	
Total:		59	

Anonymous Exam Code . :

Exam Rubric

A mark of 50% is required for a pass, a 4 and 5 are distributed evenly.

Each full answer should be started on a separate sheet. Please write your name and personal number on each sheet.

I will not be able to come to the exam. If you are unsure about how to answer a question. Make some reasonable assumptions, state your assumptions and answer the question.

Hjälpmedel:

Pen, pencil, ruler, rubber (eraser for people from the Antipodes or from across the pond) calculator.

General Comments

I can not come to the exam. If you do not understand a question then you must state any assumptions that you use to answer the questions.

1. General Questions on Distributed Systems

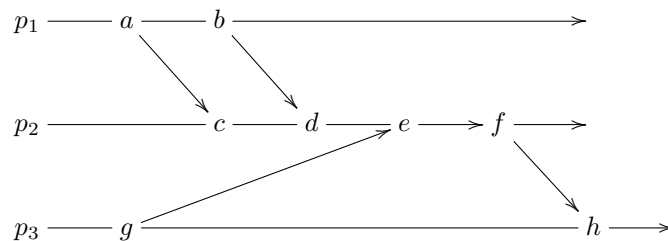
- (a) Networks delays are unbounded. Discuss how this effects the design of a distributed system. **(4 points)**
- (b) Give a breif overview of the differences between Corba and Java RMI. **(4 points)**
- (c) You are to design a distributed system which allows users to book tickets for concerts. The systems must be robust, it must allow many users to book tickets online at the same time. Using some of the ideas that you have learnt in this course outline how you would design such a system. In particular explain how the CAP theorem will affect your design.**(8 points)**

2. Clock Synchronisation

- (a) What is a leap second and why is it used? **(1 points)**
- (b) Explain the Berkeley algorithm for synchronising clocks. **(2 points)**
- (c) Suppose that you have two clocks: one with a drift of $\rho = 10^{-12} \text{seconds/seconds}$ and the other with a drift of $\rho = 10^{-5}$. Suppose that you want the clocks synchronised within 0.01 of a second. How often should the clocks be resynchronised to achieve this? **(4 points)** (Obs. Show your workings, no workings no points for a correct or incorrect answer)

3. Logical Clocks

- (a) Consider the following three processes p_1, p_2 and p_3 with the following pattern of communication:



Label the each event with a normal Lamport timestamp **(2 points)** and a vector timestamp **(2 points)**

- (b) What does it mean for two events to be concurrent and what is the relation of the Lamport timestamps of the two events. **(2 points)**.
- (c) Is it possible for two events to have the same Lamport (non vector) timestamp? If it possible give an example, if it is not possible argue why it not possible. **(2 points)**.
- (d) It is possible to use Lamport time stamps to implement a mutual exclusion algorithm. Sketch such an algorithm. **(6 points)**

4. Cuts

- (a) Define a consistent cut in a distributed system (you may use the notation used in the slides or the notation used in the book). If you are not able to define it formally you will still get some points if you define it informally. **(4 points)**
- (b) Motivate the above definition: that is, explain why it is useful. **(2 points)**
- (c) What assumptions are required on the channels in a system for the Chandy-Lamport snapshot algorithm to work. **(2 points)**
- (d) Explain with examples the Chandy-Lamport snapshot algorithm. **(6 points)**

5. Shared Memory

- (a) What is strict consistency and why is not possible to achieve in a distributed system? **(3 points)**
- (b) Define causal-consistency. You must give examples. **(2 points)**
- (c) Is the following data store sequentially consistent? Explain your answer. **(1 points)**

A	W(x)a	W(x)b	
B	R(x)a	R(x)b	
C		R(x)b	R(x)a

- (d) Explain with examples what release consistency is. **(2 points)**