Name_____ Lastname_____ Student number | | | | | | | |

Distributed Systems
academic year 2008-09

Rules

- This is a closed books exam.
- The operation of any electronic device is prohibited (e.g, no calculator, phone or PDA).
- Answer the questions being *precise, complete,* and *formal.*
- Write as *clearly* as possible, both in terms of handwriting and wording.

Questions

1. Illustrate the main characteristics of the NFS distributed file system. In particular, illustrate the architecture for access control and mounting remote directories.
2. Illustrate the five phases executed when performing a client request in a replication architecture, that is, without a primary back-up.
3. Consider three processes in a distributed system with the events depicted in Figure 1. List all happenend before relations among the 8 events. List with which events are a and b parallel, if any.

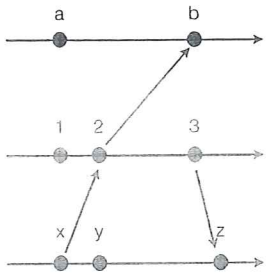

Figure 1: Events on three processes.

4. For the LCR (LeLann-Chang-Roberts) algorithm give an assignment of IDs to the processors on the unidirectional ring for which $O(n^2)$ messages are sent, and an assignment for which only $O(n)$ messages are sent. In both cases explain how message complexity is derived.
5. The Network Time Protocol can be utilized to synchronize the time on computers across a network. A NTP time server is utilized to obtain the correct time from a time source and adjust the local time in each participating computer. Consider the case of using an atomic clock for the NTP time server. The clock defines the second as 9,192,631,770 periods of the cesium-133 atom, and it diverts from real time of about one second every 15 million years. Now, two hosts $H1$ and $H2$ connect directly to the server reliably: the channel of $H1$ has a latency of 2 seconds (plus or minus 0.5 seconds), while the channel of $H2$ has a latency of 1.5 seconds (plus or minus 0.25 seconds).
   (a) What is the atomic clock resolution? What is its drift rate?
   (b) If $H1$ and $H2$ synchronize in the same instant, what will be their minimal and maximal skews?
   (c) What drift rates of the clocks of $H1$, $H2$ are tolerable, if one can accept at most a skew of 5 seconds one day after a synchronization?