Politecnico di Milano

090950 – Distributed Systems

Prof. G. Cugola – September 27th, 2016

Rules:

- **You are not allowed to use books, notes, or other material.**
- **You can answer in Italian or English.**
- **Total time for the test: 2 hours.**

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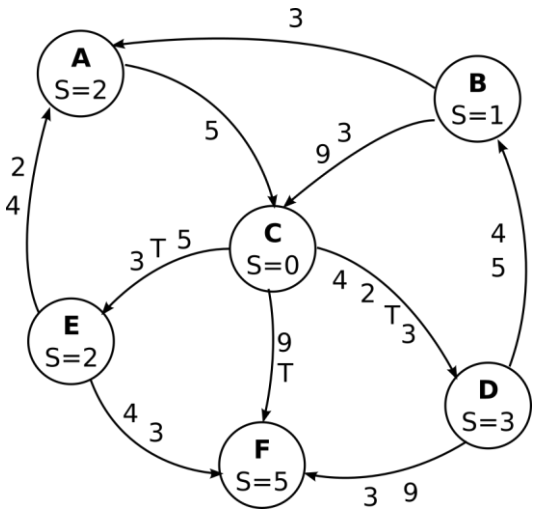
1. Describe and discuss the kind of failures (the "failure model") that may happen in a distributed system.

2. Describe the problem of removing unreferenced entities in a distributed system and possible solutions to such problem.

3. Consider the system in figure, which is running a distributed snapshot. Suppose that every process works by adding the value held by the received messages to its internal state S. Process A started the snapshot, recording state 2 and sending a token to processes C, which already processed it and sent out its own tokens. Assuming that channels exiting from C are much faster than others, and that no other operations occur apart those required to end the snapshot, show the state captured by every node at the end of the snapshot (local state and messages recorded for each link).



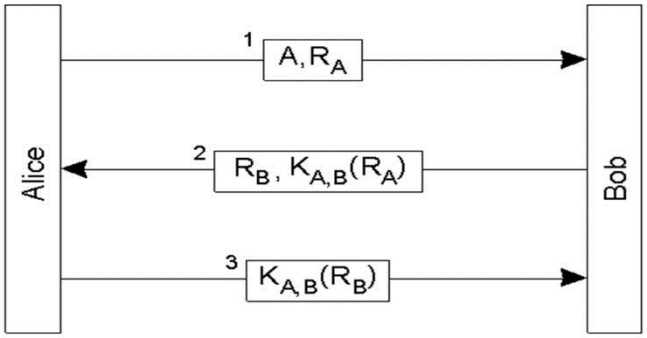
4. Describe vector clocks in general, compare them with scalar clocks and describe how the former can be used to guarantee causal delivery in a multicast communication system (clarify the assumptions you make).

5. Given the following schedule over 2 variables (both initialized with zero):

   P0 R(x)1 W(y)2 R(x)2 W(x)3
   P1 W(y)1 R(x)1 R(y)2 W(x)2
   P2 R(x)1 R(x)3 R(y)2 W(y)3
   P3 R(y)1 R(y)2 R(x)3 R(y)3

   Is it FIFO/causal/sequential consistent?

6. Describe all the security concerns regarding the message exchange shown in figure below



7. Describe the evolution of distributed systems, from client-server interactions to hybrid implementations (partly c/s, partly p2p), to full p2p implementations.