Politecnico di Milano

090950 – Distributed Systems

Prof. G. Cugola – September 24th, 2014

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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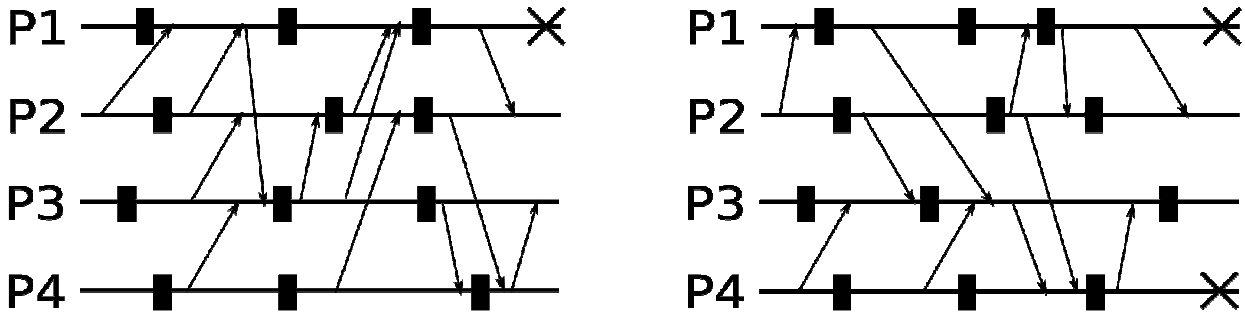
1. Describe the Christian's algorithm for time synchronization. Under which assumptions it works at best? Why?

2. Describe the problem of removing unreferenced entities in a distributed system and the various techniques to address it..

3. Calculate the recovery line for the two diagrams below using the rollback-dependency graph for the first one, the checkpoint dependency graph for the second one.



4. Describe how vector clocks can be used to guarantee causal ordering of (broadcast) messages in a distributed system. Highlights the assumptions that must hold for the protocol to operate correctly.

5. Consider the following schedule over 2 variables (both initialized at zero):

   P0 R(x)0 R(y)1 R(x)3 R(y)2
   P1 R(y)0 W(x)1 W(x)3 R(y)3
   P2 R(x)0 W(x)2 W(y)1 W(y)3
   P3 R(y)0 R(x)2 W(y)2 R(x)3

   Is it FIFO/causal/sequential consistent? If not, can you remove just one operation and make it consistent?

6. Describe the evolution of the consistency models with synchronization variables.

7. Compare the network model of Freenet with the DHT approaches, and in particular with Chord.