Politecnico di Milano – V Facoltà di Ingegneria

089081 e 075274 - Sistemi distribuiti (Ord. 270 e Ord. 509)

Prof. G. Cugola - February 25, 2011

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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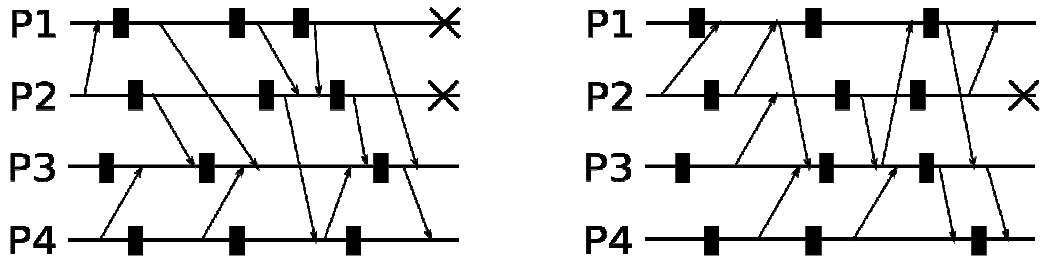
1. Implement an `Executor` class in Java. The class provides a method to execute a job (i.e., a `Runnable`) after a given delay (in ms). Suppose the jobs to execute run in a very short time. Use a single thread to manage the schedule and to execute jobs. Use only the basic synchronization facilities provided by the language (i.e., do not use the "new" library classes for synchronization).

2. Calculates the recovery line for the two diagrams below using the rollback-dependency graph for the first on, the checkpoint dependency graph for the second one.



3. Describe how to use vector clocks to get a causally ordered broadcast primitive. Suppose you had already implemented a totally ordered multicast using scalar (Lamport) clocks, could you use that primitive aa a replacement for the previous one?

4. Is it possible to get consensus among a group of processes that may fail? Under which assumptions? Using which protocol? May you prove its correctness?

5. Consider the following schedule

P0:	W(x)1	R(X)2	W(X)3	
P1:		W(X)2		W(X)4
P2:	R(X)1	R(X)2	R(X)4	R(X)3
P3:	R(X)1	R(X)2	R(X)3	R(X)4
P4:	R(X)1	R(X)3	R(X)2	

a) Do NOT consider process P4. Is the schedule composed of processes P0, P1, P2, and P3 consistent with a sequential / causal / FIFO consistency model?
In the case it is not consistent with the sequential model, it is possible to make it consistent by removing a SINGLE operation?
b) Consider also process P4. Is the schedule composed of processes P0, P1, P2, P3, and P4 consistent with a sequential / causal / FIFO consistency model?
In the case it is not consistent with the sequential model, it is possible to make it consistent by removing a SINGLE operation?
Motivate your answers.

6. In the context of access control, consider the problem of capabilities delegation using a proxy.
   a) Describe the inner structure of a proxy
   b) Consider the following scenario:
      1) A grants rights R on object O to B
      2) B grants rights R' on object O to C (R' a subset of R)

   Describe why C cannot pretend to be entitled with R, showing the complete exchange of messages between A, B, C, and the server that stores O.