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.**

1. Implement a `DoubleBuffer` class in Java. The class encapsulates two arrays of integers: `Alpha` and `Beta` (size determined at class instantiation time) and offers four methods: `addAlpha` and `addBeta` to add data (they suspend the caller if the arrays are full), `clear`, to clear both arrays, and `compute` that applies a complex computation that involves the elements of both arrays `alpha` and `beta` (imagine a static method `Foo.calc(int[], int[])` exists that performs such computation). Put your synchronization code to maximize parallelism in case the four methods would be called by different threads.

2. 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 1 and sending the tokens to processes B and E which are shown in figure. Assuming that channels exiting from A 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).
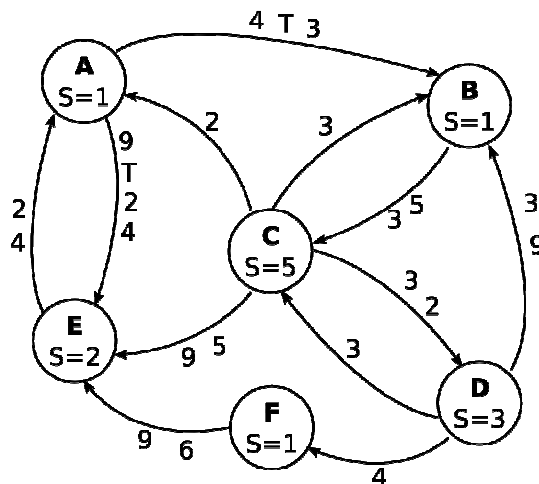
3. Describe the Cristian's algorithm to synchronize clocks. Would you use it in a WSN? Under which hypothesis?

4. Describe the techniques for reliable group communication under the hypothesis of reliable processes and unreliable channels.

5. Consider the following schedule (notice that operations are performed on two different variables, X and Y)

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

a) Do NOT consider process P3. Is the schedule composed of processes P0, P1, and P2 consistent with a sequential / causal / FIFO consistency model?

b) Consider also process P3. Is the schedule composed of processes P0, P1, P2, and P3 consistent with a sequential / causal / FIFO consistency model?

6. Consider the problem of distributing a key for secure group communication.
a) Describe the problem and explain why trivial solutions may be computationally expensive.
b) Briefly describe and compare the following protocols for efficient key distribution: logical key (tree) hierarchy and centralized flat table.