Politecnico di Milano
090950 – Distributed Systems

Prof. G. Cugola – June 18th, 2024

Rules:

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

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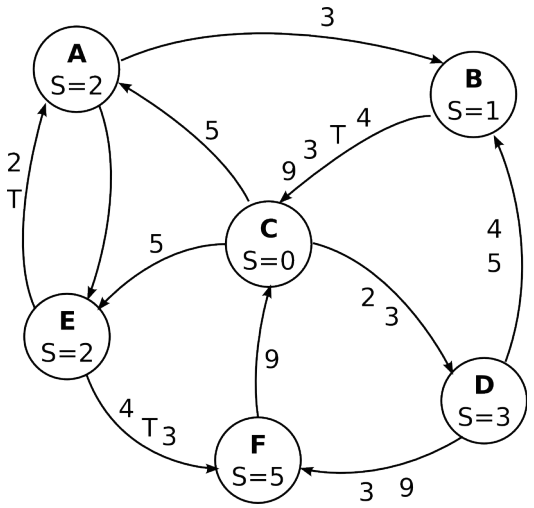
1. You want to implement an Internet radio. (a) List the specific requirements of this service that do not fit the characteristics of the IP protocol. (b) Describe the mechanisms that you could put in place to address those limitations.

2. Describe and compare the various approaches to remove unreferenced entities in a distributed system.

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 the tokens to processes B and E, which already processed them and sent out their own tokens. Show the state captured by every node at the end of the snapshot (local state and messages recorded for each link). Clarify the assumptions you made to come to the result.



4. Describe the problem of mutual exclusion and how you could solve this problem using scalar clocks. Which properties does this protocol satisfies? Under which assumptions does it operates correctly?

5.

P0	W(x) 2	W(x) 5	R(x) 4	W(y) 3	
P1	W(y) 1	W(x) 4	R(y) 1	R(y) 3	
P2	R(y) 1	R(x) 2	R(y) 3	R(x) 5	R(x) 4

Consider the above schedule of read and write operations on a replicated data store. Is the schedule consistent with the FIFO, causal, and sequential consistency models? How do your answers change if you remove the last read (R(x) 4) from P2? Motivate your answers.

6. Three peers (IDs = 2, 6, 11) participate in a circular DHT with finger table using the CHORD protocol. Assume that the DHT uses 4-bits to represent the node IDs and the Keys. (a) Show the routing tables of the three peers. (b) Peer 2 wants to retrieve the value of an object having key 7. Show the exchange of messages required to search the desired value and the line in the finger table each node uses to route the search message.

7. Consider the dataflow model for big data processing. (a) Describe the key characteristics of the model. (b) Describe what are the two architectures to implement it: scheduling of tasks and pipelining of tasks.