

Distributed Systems 14/06/2018
Corso di Laurea Magistrale in Ingegneria Informatica

☐ **5 Credits**

☐ **6 out of 12 Credits (not passed CNS yet)**

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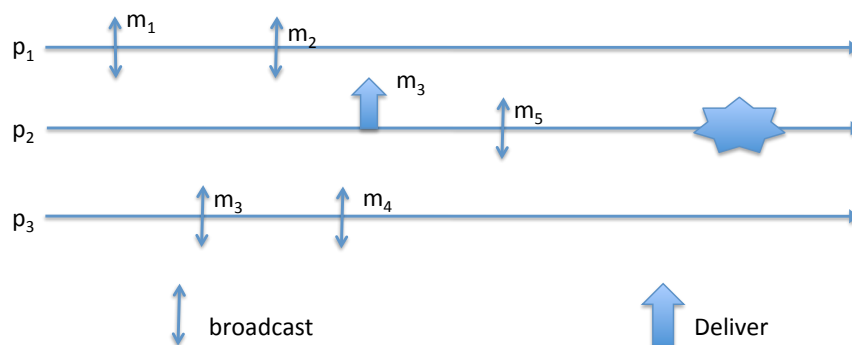
Family Name _____ Name _____ Student ID _____

Ex 1: Describe the functioning of the “Majority Voting” algorithm used to implement distributed regular registers. Detail the corresponding system model. Explain how this algorithm satisfies the Validity and Termination properties of the specification.

Ex 2: Describe the *active replication* scheme, and discuss the following points:

1. Assume that processes are provided with a *best effort broadcast* primitive. How does the algorithm functioning change and how should the algorithm be modified to be correct?
2. How does the algorithm functioning change if f replicas may be Byzantine faulty? How should the algorithm be modified to be correct?

Ex 3: Consider the partial execution depicted in the following figure:



1. Complete the execution (by adding delivery of messages) in order to obtain a run satisfying *Non Uniform Reliable Broadcast*.
2. Complete the execution (by adding delivery of messages) in order to obtain a run satisfying *Uniform Reliable Broadcast*.
3. Considering the two runs provided in point 1 and 2, do they satisfy some ordering property? If so, which type of ordering?

Ex 4: Consider a distributed system composed by n processes $p_1, p_2 \dots p_n$ with unique and totally ordered identifiers. Every process p_i can access a local physical clock CK_i . Clocks are synchronized with accuracy D and their drift rates can be considered negligible. Processes can fail by crashing.

1. Write the pseudo-code of an algorithm implementing a Total Order Broadcast specification satisfying the SUTO property and using the following primitives:

Timely Best-Effort-Broadcast:

- No message is delivered more than once;
- If a message m is delivered by some process p_j , then m has been previously broadcasted by some process p_i
- If a correct process p_i broadcast a message m at time t , every correct process p_j will deliver m within time $t + \delta$ (con $\delta > 0$). (Non-correct processes can either deliver within time $t + \delta$ or will not deliver)

Timely Perfect Failure Detector:

- If a process p_i crashes at time t , every correct process p_j will suspect p_i within time $t + \delta'$ (con $\delta' > 0$).
- If a process p_i is suspected by a process p_j , then p_i has crashed.

2. Discuss which kind of *agreement* (UA, NUA or none) is satisfied by your solution, providing execution examples as a motivation.

According to the Italian law 675 of the 31/12/96, I authorize the instructor of the course to publish on the web site of the course results of the exams.

Signature: _____