Distributed Systems 06/07/2018
Corso di Laurea Magistrale in Ingegneria Informatica
Corso di Laurea Magistrale in Cyber Security

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

☐ **6 Credits** ☐ **6 out of 12 Credits (passed CNS)**

(tick the appropriate box above – write clear below)

Family Name_____Name_____Student ID_____

Ex 1: Consider the following algorithm

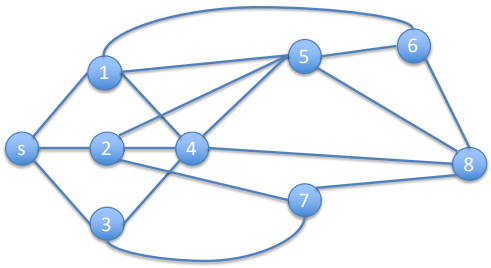
Init:
sn=0; last[]=[0]^n; pending=∅; neighbors=%set of neighbors for the current process.

upon event xCast(m):
sn=sn+1;
for each $p_j \in$ neighbors **do**
send MSG (m, sn, myId) to p_j
trigger XDeliver(m)

upon event rcv(m, sn_m, src, id):
if src=id and src ∈ neighbors and sn_m > last[src]
then trigger XDeliver(m)
last[src]=sn_m
for each $p_j \in$ neighbors **do**
send MSG (m, sn_m, src, myId) to p_j
else
pending = pending ∪ {<m, sn_m, src, id>}

when exists <m, sn_m, src> occurring at least f+1 times in pending and such that sn_m > last[src]:
trigger XDeliver(m)
last[src]=sn_m
for each $p_j \in$ neighbors **do**
send MSG (m, sn_m, src, myId) to p_j

Consider the network depicted above

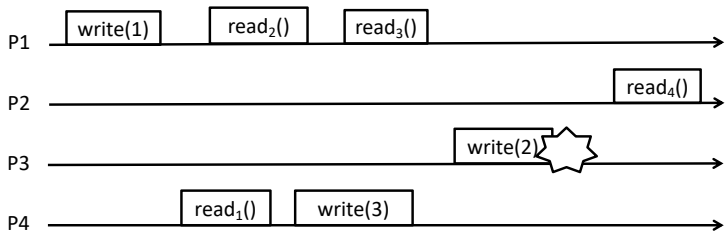


Answer to the following questions:

Let us assume that (i) each channel depicted in the figure is an authenticated perfect point-to-point link, (ii) up to f processes may by Byzantine in each neighborhood and (iii) each correct process executes the algorithm in Figure.
Discuss the truthfulness of the following sentences when f=1.

1. If a correct process p delivers a message m, them m has been previously broadcasted by a correct process q.
2. If a correct process p broadcast m then every correct process will eventually deliver m.
3. Let us consider two messages m and m' broadcasted by the same source q. If a process p delivers m before than m', then m has been sent before than m' from q.

Ex 2: Consider the execution depicted in the following figure and answer the questions



1. Define ALL the values that can be returned by read operations (Rx) assuming the run refers to a regular register.
2. Define ALL the values that can be returned by read operations (Rx) assuming the run refers to an atomic register.

Ex 3: Describe the flooding consensus algorithm and discuss its correctness. Furthermore, discuss why this algorithm does not satisfy the uniform consensus specification (use examples whenever appropriate).

Ex 4: Consider a distributed system constituted by *n* processes $\prod=\{p_1, p_2 \ldots p_n\}$ with unique identifiers that exchange messages through fair-loss point-to-point links and are structured through a line (i.e., each process p_i can exchange messages only with processes p_{i-1} and p_{i+1} when they exists). Processes are not going to fail.
Write the pseudo-code of an algorithm implementing FIFO Reliable Broadcast.

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: _____