Distributed Systems 9/01/2017
Corso di Laurea Magistrale in Ingegneria Informatica

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

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

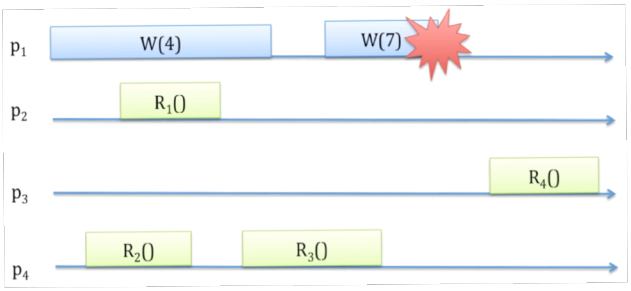
(tick the appropriate box above – write clear below)

Family Name_____Name_____Student ID_____

Ex 1: Detail how the structure of a regular consensus algorithm changes moving from a synchronous system to an eventually synchronous one.

Ex 2: Consider the FIFO, Causal and Total Order broadcast primitives. Describe the relations (equivalence, orthogonality, inclusion) that exist among them, providing examples (runs) as a motivation to your answer.

Ex 3: Consider the operations executed on a (1,N) register shown in the run below.

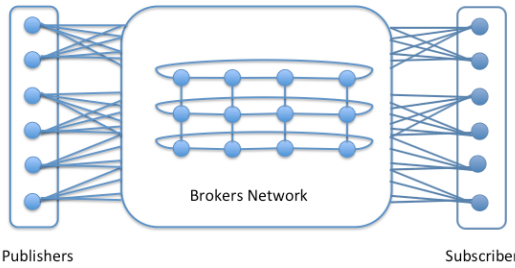


Assuming that the initial value of the register is 0, answer the following questions:

1. List the value returned by each read operation considering the register be regular. Explain why.
2. List the value returned by each read operation considering the register be atomic. Explain why.

Ex 4: Describe properties of *fair-loss*, *stubborn* and *perfect* point-to-point channels. In addition, discuss the relationship between point-to-point channels abstraction and TCP/UDP protocols.

Ex 5: Let us consider a distributed system composed by publishers, subscribers and brokers. Processes are arranged in a network made as follows and depicted below:



1. Each publisher is connected to k brokers trough perfect point-to-point links;
2. Each subscriber is connected to k brokers trough perfect point-to-point links;
3. Each broker is connected to k brokers trough perfect point-to-point links and the resulting broker network is k-connected [1](4-connected in the example);

Answer to the following questions:

1. Write the pseudo-code of an algorithm implementing the event-flooding dissemination scheme assuming that processes are not going to fail.
2. Discuss how many crash failures the proposed algorithm can tolerate.
3. Modify the proposed algorithm in order to tolerate f Byzantine processes in the broker network and discuss the relation between f and k.

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: _____

[1] Let us recall that a graph G is said to be k-connected if there does not exist a set of k-1 vertices whose removal disconnects the graph.