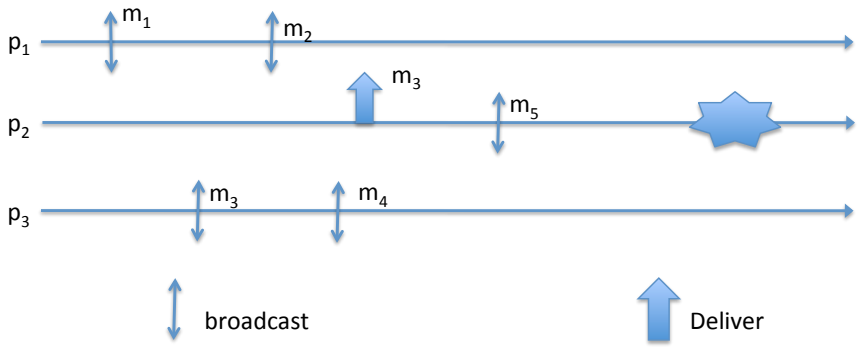
Distributed Systems
Master of Science in Engineering in Computer Science

AA 2020/2021

Lecture 9 – Exercises
November 5th, 2020

Ex 1: Consider the partial execution depicted in the following figure:



1. Complete the execution in order to obtain a run satisfying *Best Effort Broadcast* but *not Reliable Broadcast.*
2. Complete the execution in order to obtain a run satisfying *Regular Reliable Broadcast* but *not Uniform Reliable Broadcast.*
3. Complete the execution in order to obtain a run satisfying *Uniform Reliable Broadcast.*

Ex 2: Consider a distributed system composed by n processes $\{p_1,p_2,\ldots,p_n\}$. Each process is connected to all the others trough fair-loss point-to-point links and has access to a perfect failure detector.

Write the pseudo-code of an algorithm implementing a Uniform Reliable Broadcast primitive.

Additionally, answer to the following questions:

1. Is it possible to provide a quiescent implementation of the Uniform Reliable Broadcast primitive?
2. Given the system model described here, is it possible to provide an implementation that uses only data structure with finite size?

Ex 3: Consider a distributed system composed by N servers $\{s_1, s_2, \ldots s_n\}$ and M clients $\{c_1, c_2, \ldots c_m\}$.
Each client c_i runs its algorithm and it can request to servers the execution of a particular task T_i. Servers will execute the task T_i and, after that, a notification will be sent to c_i that T_i has been completed.
The Figure shows the code executed by a generic client c_i.

Operation executeTask (T_i)	Upon pp2pdeliver (TASK_COMPLETED, T_i) from s_j
1. For each $s_i \in \{s_1, s_2, \ldots s_n\}$ 2. pp2psend (TASK_REQ, T_i, c_i) to s_i;	1. **trigger** completedTask (T_i);

Write the pseudo-code of an algorithm, executed by servers, able to allocate tasks assuming that:

- Once clients ask for a task execution, they remain blocked until the task is not terminated.
- Any two clients c_i and c_j can concurrently require the execution of two different tasks T_i and T_j;
- Each task is univocally identified by the pair (T_i, c_i);
- Each server can manage at most one task at every time;
- At most N-1 servers can crash;
- Servers can use a uniform consensus primitive;
- Servers can use a failure detector P;
- Servers communicate through a uniform reliable broadcast primitive.

Note that, if a server crashes while executing a task, such task needs to be re-allocated and re-processed by a different server.

Ex 4: Consider a distributed system formed by n processes p_1, p_2, …, p_n connected along a ring i.e., a process p_i is initially connected to a process $p_{(i+1) \bmod n}$ through a unidirectional perfect point-to-point link.
Write the pseudo-code of a distributed algorithm implementing a consensus primitive.