Exam

CS 247: Principles of Distributed Computing
Spring 2020
Time: 70 mins
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Email title: CS 247 Exam

1. (40 points)
What happens in the reliable broadcast (RB) and uniform reliable broadcast (URB) algorithms if the (a) completeness, (b) accuracy property of the failure detector is violated? Show example execution diagrams if any of the four properties of broadcast is is violated. Answer for RB.(a), RB.(b), URB.(a), and URB.(b) separately.
Hint: The same diagram can show the violation of more than one property at the same time. You only need a total of three diagrams.

2. (20 points)
Consider the following causal broadcast algorithm.

```
ReliableCausalOrderBroadcast
Uses: ReliableBroadcast (rb).
1  upon event <Init> do
2     for all pi in S: VC[pi] := 0;
3  upon event <rcoBroadcast, m> do
4     VC[self] := VC[self] + 1;
5     trigger <rbBroadcast, [Data,VC,m]>;
6  upon event <rbDeliver, pj, [Data,VCm,m]> do
7     wait until ((VC[pj] = VCm[pj] - 1) and
8                  (for all pk ? pj: VC[pk]>= VCm[pk]));
9        trigger <rcoDeliver, pj,m>;
10    if pj ? self then
11       VC[pj] := VC[pj] + 1
```

If the equality in line 7 is changed to (a) > and (b) <= , is the (1) causal order property (safety) and (2) eventual delivery (liveness) violated? Answer for (a, 1), (a, 2), (b, 1) an (b, 2) separately.

3. (15 points)
Consider the regular register algorithm for fail-silent model that assumes a majority of the processes are correct (the last regular algorithm). If the algorithm does not use timestamps, regularity is violated. Show an example execution diagram (with arrows showing the delivery of messages) for the following execution that shows the violation of regularity: a sequence of two writes W(0), W(1) and then later a read R().
Hint: Use five processes where the size of a majority quorum is three. Note that some messages form the processes that are not in the quorum can be delivered late.

4. (20 points)
Let us consider a variant of the consensus algorithm II (the uniform consensus algorithm that uses a perfect failure detector). In this variant, the last process pn skips broadcasting its value in round n. Is this algorithm correct? Why?