Distributed Algorithms

Fall 2020

Causal & Total Order Broadcast
4th exercise session, 14/10/2019

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Exercise 1

Would it make sense to add the total-order property to the best-effort broadcast?

Exercise 2

What happens in our "Consensus-Based Total-Order Broadcast" algorithm, if the set of messages delivered in a round is not sorted deterministically after deciding in the consensus abstraction, but before it is proposed to consensus?

What happens in that algorithm if the set of messages decided on by consensus is not sorted deterministically at all?

Consensus-Based Total-Order Broadcast algorithm

upon event $\langle$ *tob*, *Init* $\rangle$ **do**
    unordered := $\emptyset$;
    delivered := $\emptyset$;
    round := 1;
    wait := FALSE;

upon event $\langle$ *tob*, *Broadcast* | m $\rangle$ **do**
    trigger $\langle$ *rb*, *Broadcast* | m $\rangle$;

upon event $\langle$ *rb*, *Deliver* | p, m $\rangle$ **do**
    if $m \notin$ *delivered* **then**
        unordered := *unordered* $\cup \{(p, m)\}$;

upon *unordered* $\neq \emptyset \wedge$ *wait* = FALSE **do**
    wait := TRUE;
    Initialize a new instance *c.round* of consensus;
    trigger $\langle$ *c.round*, *Propose* | *unordered* $\rangle$;

upon event $\langle$ *c.r*, *Decide* | *decided* $\rangle$ **such that** r = *round* **do**
    // by the order in the resulting sorted list
    forall $(s, m) \in$ *sort*(*decided*) **do**
        trigger $\langle$ *tob*, *Deliver* | s, m $\rangle$;
    delivered := *delivered* $\cup$ *decided*;
    unordered := *unordered* $\setminus$ *decided*;
    round := *round* + 1;
    wait := FALSE;

Exercise 3

The "Consensus-Based Total-Order Broadcast" algorithm transforms a consensus abstraction (together with a reliable broadcast abstraction) into a total-order broadcast abstraction.

Describe a transformation between these two primitives in the other direction, that is, implement a (uniform) consensus abstraction from a (uniform) total-order broadcast abstraction.