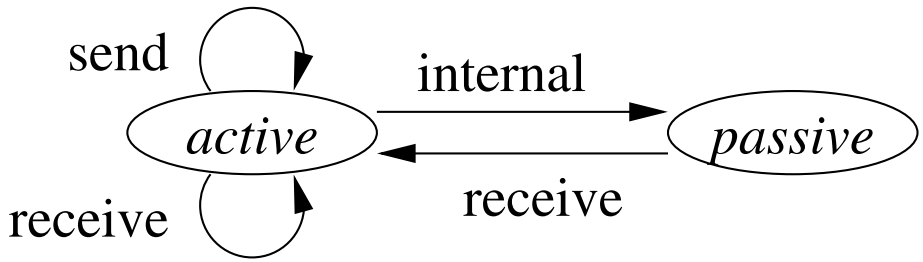
Termination detection

The *basic* algorithm is terminated if (1) each process is passive, and (2) no basic messages are in transit.



The *control* algorithm concerns termination detection and announcement.

Announcement is simple; we focus on detection.

Termination detection shouldn't influence basic computations.

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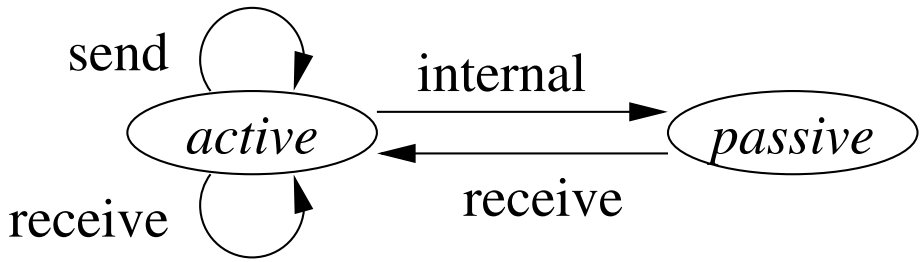

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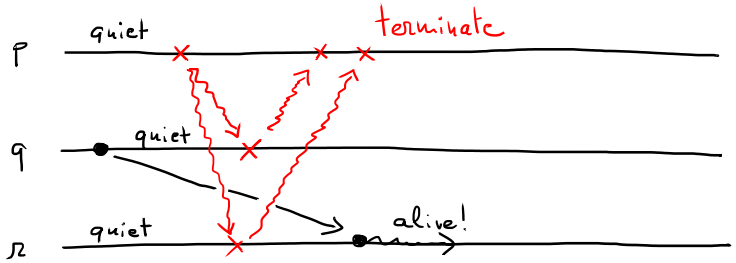
Question

Why is the following termination detection algorithm not correct ?

- If a process becomes quiet

  then it starts a wave (tagged with its id).
- Only quiet processes take part in the wave.
- If the wave completes, its initiator calls *Announce*.

wave-like termination v.1 (no ack)



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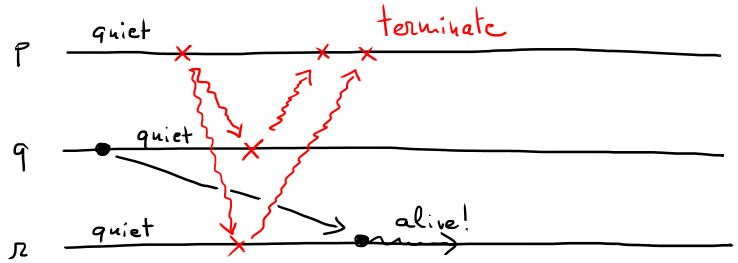
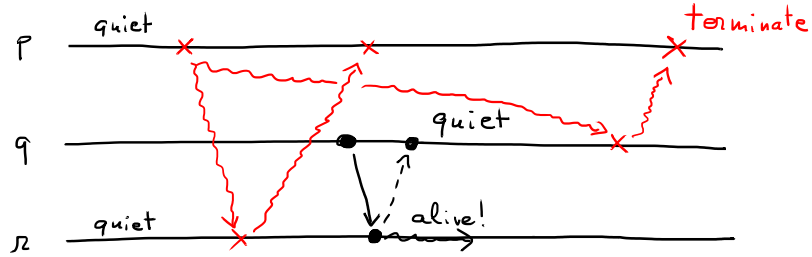
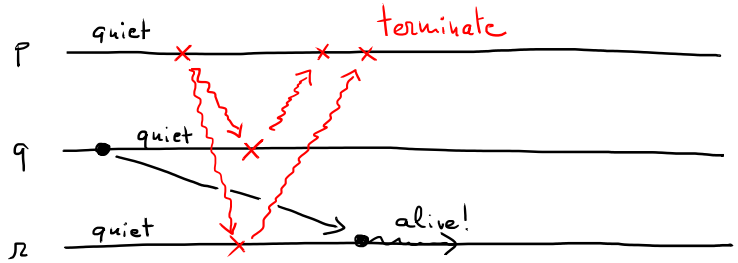


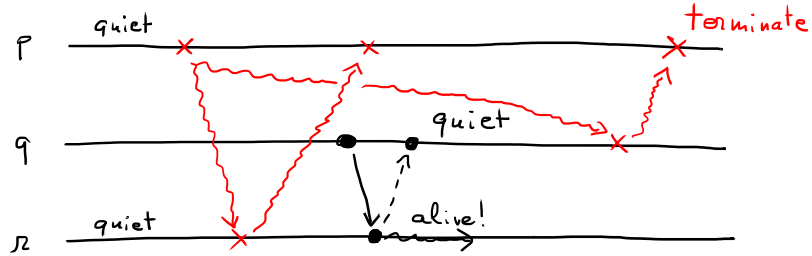
wave-like termination v.2 (with ack)



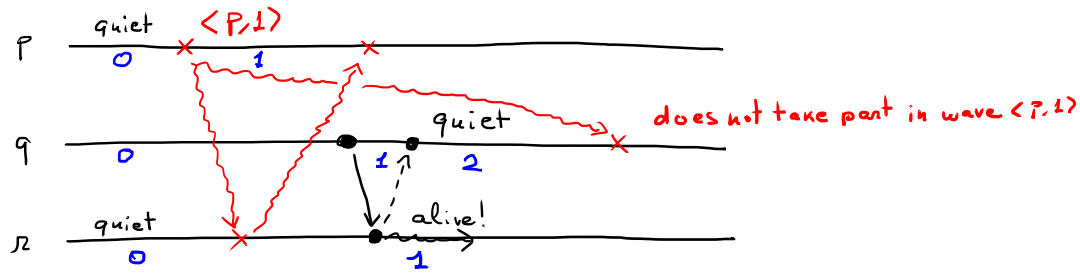
wave-like termination v.1 (no ack)



wave-like termination v.2 (with ack)



wave-like termination v.3 (with ack + timestamp) = Rana's algorithm (decentralized)



Dijkstra-Scholten algorithm

Requires a centralized basic algorithm, and an undirected network.

A *tree* T is maintained, which has the initiator p_0 as the root, and includes all active processes. *Initially*, T consists of p_0.

cc_p estimates (from above) the number of children of process p in T.

- When p sends a basic message, $cc_p \leftarrow cc_p + 1$.
- Let this message be received by q.
  - If q isn't yet in T, it joins T with parent p and $cc_q \leftarrow 0$.
  - If q is already in T, it sends a control message to p that it isn't a new child of p. Upon receipt of this message, $cc_p \leftarrow cc_p - 1$.
- When a noninitiator p is passive and $cc_p = 0$, it quits T and informs its parent that it is no longer a child.
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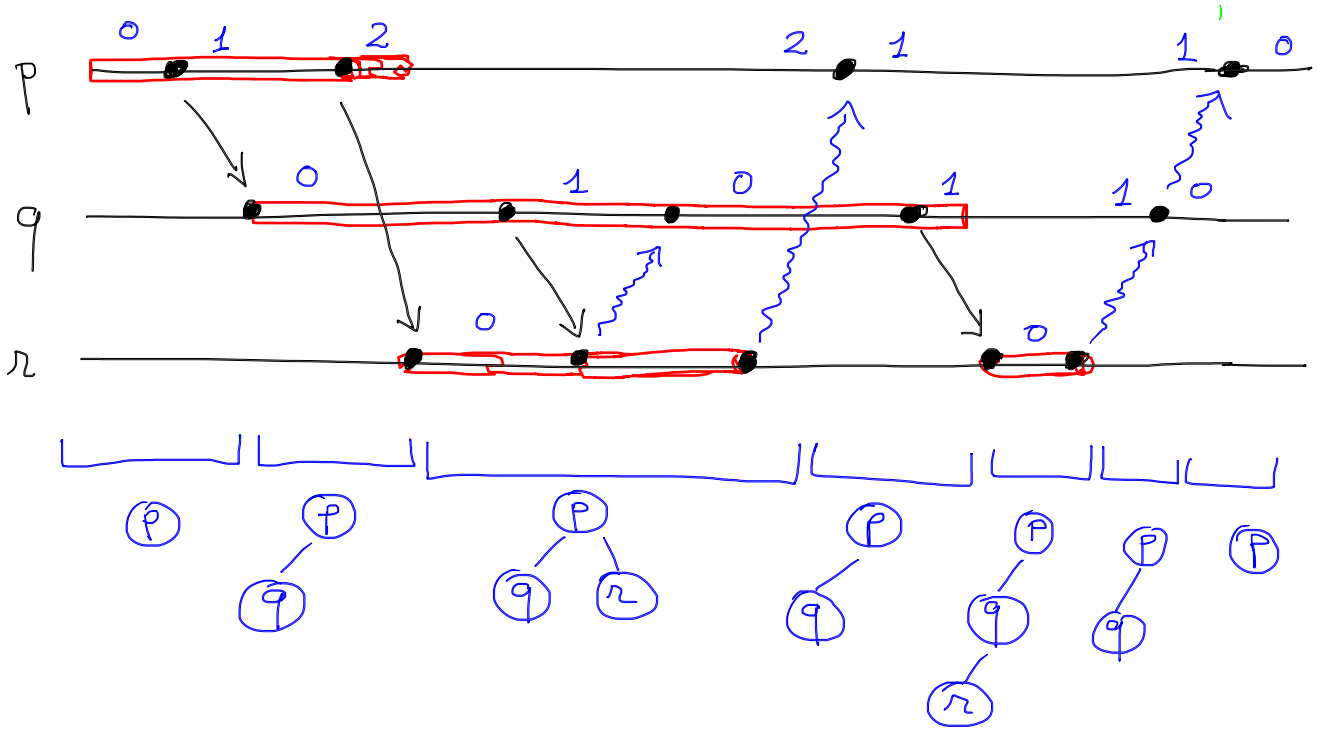
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Question

What is a drawback of the Dijkstra-Scholten as well as Rana's algorithm ?

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Answer: Requires one control message for every basic message.

Weight-throwing termination detection

Requires a centralized basic algorithm;
allows a directed network.

The initiator has weight 1, all noninitiators have weight 0.

When a process *sends* a basic message, it transfers part of its weight to this message.

When a process *receives* a basic message, it adds the weight of this message to its own weight.

When a noninitiator becomes passive, it returns its weight to the initiator.

When the initiator becomes passive, and has regained weight 1, it calls *Announce*.

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Question

What is a weakness of weight-throwing termination detection ?

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Underflow: The weight of a process can become too small to be divided further.

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Solution 2: The process initiates a weight-throwing termination detection sub-call, and only returns its weight to the initiator when it has become passive and this sub-call has terminated.