Leader-election protocol

The following protocol is due to Dolew, Klawe, Rodeh (1982).

The protocol consists of $n$ participants (where $n$ is a parameter). The participants are connected by a ring of unidirectional message channels. Communication is asynchronous, and the channels are reliable. Each participant has a unique ID (e.g., some random number).

**Goal:** The participants communicate to elect a “leader” (i.e., some distinguished participant). The protocol shown here ensures low communication overhead ($\mathcal{O}(n \log n)$ messages; most naïve protocols have quadratic message overhead).
Leader-election protocol

Participants are either active or inactive. Initially, all participants are active.

The protocol proceeds in rounds. In each round, at least half of the participants will become inactive. (As a consequence, there are at most $O(\log n)$ rounds.

In each round every active participant receives the numbers of the two nearest active participants (in incoming direction). A participant remains active only if the value of the nearest neighbour is the largest of the three. (In the following slides, the participant adopts this largest number as its own; this is optional.)

The last remaining active participant is declared the leader.
Leader Election: Example
Leader Election: First round
Leader Election: Result of the first round
Leader Election: Second round
Leader Election: Result of the second round

\[ \ldots \rightarrow \ldots \rightarrow 9 \rightarrow \ldots \rightarrow \ldots \rightarrow \ldots \rightarrow \ldots \rightarrow \ldots \rightarrow \ldots \rightarrow 10 \rightarrow \ldots \]

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Leader Election: Third round

... → ... → 9 \( (10) \) → ... → ... → ... → 10 → ... → ...

... → ...

... → ...

... → ...

... → ...
Leader Election: Final result

![Diagram of leader election process with node 10 and unspecified nodes labeled with ellipses.]