Algorithms – Sequence Consensus

Algorithm 1 Sequence Paxos

Implements:

SequenceConsensus, **instance** *sc*.

Uses:

BallotLeaderElection, **instance** *ble*.
FIFOPerfectPointToPointLinks, **instance** *fifop2p*.

```
upon event ⟨ Init ⟩ do
    $propCmds := \langle\rangle$
    $las := [0]^N$
    $lds := [\perp]^N$
    $l_c := 0$
    $acks := [\perp]^N$
    $(n_L, leader) = (0, \perp)$
    $state = (\text{FOLLOWER}, \perp)$
    $n_{prom} := 0$
    $n_a := 0$
    $v_a := \langle\rangle$
    $l_d := 0$
```

Algorithm 2 Sequence Paxos (continued)

```
upon event $\langle$ $ble, Leader \mid L, n$ $\rangle$ do
    if $n > n_L$ then
        $leader := L$
        $n_L := n$
        if $self = L \land n_L > n_{prom}$ then
            $state := (\textsc{leader}, \textsc{prepare})$
            $propCmds := \langle\rangle$
            $las := [0]^N$
            $lds := [\bot]^N$
            $acks := [\bot]^N$
            $l_c := 0$
            for all $p \in \Pi \setminus \{self\}$ do
                trigger $\langle$ $fifop2p, Send \mid p, [\textsc{Prepare}, n_L, l_d, n_a]$ $\rangle$
            $acks[L] := (n_a, \text{suffix}(v_a, l_d))$
            $lds[self] := l_d$
            $n_{prom} := n_L$
        else
            $state := (\textsc{follower}, state.2)$

upon event $\langle$ $fifop2p, Deliver \mid p, [\textsc{Prepare}, n_p, ld, n]$ $\rangle$ do
    if $n_{prom} < n_p$ then
        $n_{prom} := n_p$
        $state := (\textsc{follower}, \textsc{prepare})$
        if $n_a \geq n$ then
            $sfx := \text{suffix}(v_a, ld)$
        else
            $sfx := \langle\rangle$
        trigger $\langle$ $fifop2p, Send \mid p, [\textsc{Promise}, n_p, n_a, sfx, l_d]$ $\rangle$
```

Algorithm 3 Sequence Paxos (continued)

```
upon event $\langle$ $\mathit{fifop2p}, \mathit{Deliver} \mid a, [\textsc{Promise}, n, n_a, \mathit{sfx}_a, \mathit{ld}_a]$ $\rangle$ do
    if $n = n_L \land \mathit{state} = (\textsc{leader}, \textsc{prepare})$ then
        $\mathit{acks}[a] := (n_a, \mathit{sfx}_a)$
        $\mathit{lds}[a] := \mathit{ld}_a$
        $P := \{p \in \Pi \mid \mathit{acks}[p] \neq \bot\}$
        if $|P| = \lceil \frac{N+1}{2} \rceil$ then
            $(k, \mathit{sfx}) := \max\{\mathit{acks}[p] \mid p \in P\}$                    ▷ adopt v
            $v_a := \text{prefix}(v_a, l_d) + \mathit{sfx} + \mathit{propCmds}$
            $\mathit{las}[\mathit{self}] := |v_a|$
            $\mathit{propCmds} := \langle\rangle$
            $\mathit{state} := (\textsc{leader}, \textsc{accept})$
            for all $p \in \{p \in \Pi \mid \mathit{lds}[p] \neq \bot \land p \neq \mathit{self}\}$ do
                $\mathit{sfx}_p := \text{suffix}(v_a, \mathit{lds}[p])$
                trigger $\langle$ $\mathit{fifop2p}, \mathit{Send} \mid p, [\textsc{AcceptSync}, n_L, \mathit{sfx}_p, \mathit{lds}[p]]$ $\rangle$
    else if $n = n_L \land \mathit{state} = (\textsc{leader}, \textsc{accept})$ then
        $\mathit{lds}[a] := \mathit{ld}_a$
        $\mathit{sfx} := \text{suffix}(v_a, \mathit{lds}[a])$
        trigger $\langle$ $\mathit{fifop2p}, \mathit{Send} \mid a, [\textsc{AcceptSync}, n_L, \mathit{sfx}, \mathit{lds}[a]]$ $\rangle$
        if $l_c \neq 0$ then
            trigger $\langle$ $\mathit{fifop2p}, \mathit{Send} \mid a, [\textsc{Decide}, l_d, n_L]$ $\rangle$

upon event $\langle$ $\mathit{fifop2p}, \mathit{Deliver} \mid p, [\textsc{AcceptSync}, n_L, \mathit{sfxv}, \mathit{ld}]$ $\rangle$ do
    if $\mathit{state} = (\textsc{follower}, \textsc{prepare})$ then
        if $n_{\mathit{prom}} = n_L$ then
            $n_a := n_L$
            $v_a := \text{prefix}(v_a, \mathit{ld}) + \mathit{sfxv}$
            trigger $\langle$ $\mathit{fifop2p}, \mathit{Send} \mid p, [\textsc{Accepted}, n_L, |v_a|]$ $\rangle$
            $\mathit{state} := (\textsc{follower}, \textsc{accept})$

upon event $\langle$ $\mathit{fifop2p}, \mathit{Deliver} \mid p, [\textsc{Accept}, n_L, C]$ $\rangle$ do
    if $\mathit{state} = (\textsc{follower}, \textsc{accept})$ then
        if $n_{\mathit{prom}} = n_L$ then
            $v_a := v_a + \langle C \rangle$
            trigger $\langle$ $\mathit{fifop2p}, \mathit{Send} \mid p, [\textsc{Accepted}, n_L, |v_a|]$ $\rangle$
```

Algorithm 4 Sequence Paxos (continued)

```
upon event $\langle$ fifop2p, Deliver $\mid p, [\textsc{Decide}, l, n_L]$ $\rangle$ do
    if $n_{prom} = n_L$ then
        while $l_d < l$ do
            trigger $\langle$ sc, Decide $\mid v_a[l_d]$ $\rangle$
            $l_d := l_d + 1$

upon event $\langle$ sc, Propose $\mid C$ $\rangle$ do
    if $state = (\textsc{leader}, \textsc{prepare})$ then
        $propCmds := propCmds + \langle C \rangle$
    else if $state = (\textsc{leader}, \textsc{accept})$ then
        $v_a := v_a + \langle C \rangle$
        $las[self] := las[self] + 1$
        for all $p \in \{p \in \Pi \mid lds[p] \neq \bot \wedge p \neq self\}$ do
            trigger $\langle$ fifop2p, Send $\mid p, [\textsc{Accept}, n_L, C]$ $\rangle$

upon event $\langle$ fifop2p, Deliver $\mid a, [\textsc{Accepted}, n, m]$ $\rangle$ do
    if $state = (\textsc{leader}, \textsc{accept}) \wedge n = n_L$ then
        $las[a] := m$
        if $l_c < m \wedge |\{p \in \Pi \mid las[p] \geq m\}| \geq \lceil \frac{N+1}{2} \rceil$ then
            $l_c := m$
            for all $p \in \{p \in \Pi \mid lds[p] \neq \bot\}$ do
                trigger $\langle$ fifop2p, Send $\mid p, [\textsc{Decide}, l_c, n_L]$ $\rangle$
```