

# Algorithms – Sequence Consensus

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**Algorithm 1** Sequence Paxos

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**Implements:**SequenceConsensus, **instance** *sc*.**Uses:**BallotLeaderElection, **instance** *ble*.FIFOPerfectPointToPointLinks, **instance** *fifo2p*.

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1: upon event  $\langle \text{Init} \rangle$  do
2:    $\text{propCmds} := \langle \rangle$ 
3:    $\text{las} := [0]^N$ 
4:    $\text{lds} := [\perp]^N$ 
5:    $l_c := 0$ 
6:    $\text{acks} := [\perp]^N$ 
7:    $(n_L, \text{leader}) = (0, \perp)$ 
8:    $\text{state} = (\text{FOLLOWER}, \perp)$ 
9:    $n_{\text{prom}} := 0$ 
10:   $n_a := 0$ 
11:   $v_a := \langle \rangle$ 
12:   $l_d := 0$ 
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**Algorithm 2** Sequence Paxos (continued)

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13: upon event  $\langle ble, Leader \mid L, n \rangle$  do
14:   if  $n > n_L$  then
15:      $leader := L$ 
16:      $n_L := n$ 
17:     if  $self = L \wedge n_L > n_{prom}$  then
18:        $state := (LEADER, PREPARE)$ 
19:        $propCmds := \langle \rangle$ 
20:        $las := [0]^N$ 
21:        $lds := [\perp]^N$ 
22:        $acks := [\perp]^N$ 
23:        $l_c := 0$ 
24:       for all  $p \in \Pi \setminus \{self\}$  do
25:         trigger  $\langle fifop2p, Send \mid p, [PREPARE, n_L, l_d, n_a] \rangle$ 
26:          $acks[L] := (n_a, suffix(v_a, l_d))$ 
27:          $lds[self] := l_d$ 
28:          $n_{prom} := n_L$ 
29:     else
30:        $state := (FOLLOWER, state.2)$ 

31: upon event  $\langle fifop2p, Deliver \mid p, [PREPARE, n_p, ld, n] \rangle$  do
32:   if  $n_{prom} < n_p$  then
33:      $n_{prom} := n_p$ 
34:      $state := (FOLLOWER, PREPARE)$ 
35:     if  $n_a \geq n$  then
36:        $sfx := suffix(v_a, ld)$ 
37:     else
38:        $sfx := \langle \rangle$ 
39:     trigger  $\langle fifop2p, Send \mid p, [PROMISE, n_p, n_a, sfx, l_d] \rangle$ 
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**Algorithm 3** Sequence Paxos (continued)

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40: upon event  $\langle \text{fifop2p}, \text{Deliver} \mid a, [\text{PROMISE}, n, n_a, \text{sfx}_a, \text{ld}_a] \rangle$  do
41:   if  $n = n_L \wedge \text{state} = (\text{LEADER}, \text{PREPARE})$  then
42:      $\text{acks}[a] := (n_a, \text{sfx}_a)$ 
43:      $\text{lds}[a] := \text{ld}_a$ 
44:      $P := \{p \in \Pi \mid \text{acks}[p] \neq \perp\}$ 
45:     if  $|P| = \lceil \frac{N+1}{2} \rceil$  then
46:        $(k, \text{sfx}) := \max\{\text{acks}[p] \mid p \in P\}$  ▷ adopt v
47:        $v_a := \text{prefix}(v_a, \text{ld}) + \text{sfx} + \text{propCmds}$ 
48:        $\text{las}[\text{self}] := |v_a|$ 
49:        $\text{propCmds} := \langle \rangle$ 
50:        $\text{state} := (\text{LEADER}, \text{ACCEPT})$ 
51:       for all  $p \in \{p \in \Pi \mid \text{lds}[p] \neq \perp \wedge p \neq \text{self}\}$  do
52:          $\text{sfx}_p := \text{suffix}(v_a, \text{lds}[p])$ 
53:         trigger  $\langle \text{fifop2p}, \text{Send} \mid p, [\text{ACCEPTSYNC}, n_L, \text{sfx}_p, \text{lds}[p]] \rangle$ 
54:     else if  $n = n_L \wedge \text{state} = (\text{LEADER}, \text{ACCEPT})$  then
55:        $\text{lds}[a] := \text{ld}_a$ 
56:        $\text{sfx} := \text{suffix}(v_a, \text{lds}[a])$ 
57:       trigger  $\langle \text{fifop2p}, \text{Send} \mid a, [\text{ACCEPTSYNC}, n_L, \text{sfx}, \text{lds}[a]] \rangle$ 
58:       if  $l_c \neq 0$  then
59:         trigger  $\langle \text{fifop2p}, \text{Send} \mid a, [\text{DECIDE}, \text{ld}, n_L] \rangle$ 

60: upon event  $\langle \text{fifop2p}, \text{Deliver} \mid p, [\text{ACCEPTSYNC}, n_L, \text{sfx}_v, \text{ld}] \rangle$  do
61:   if  $\text{state} = (\text{FOLLOWER}, \text{PREPARE})$  then
62:     if  $n_{\text{prom}} = n_L$  then
63:        $n_a := n_L$ 
64:        $v_a := \text{prefix}(v_a, \text{ld}) + \text{sfx}_v$ 
65:       trigger  $\langle \text{fifop2p}, \text{Send} \mid p, [\text{ACCEPTED}, n_L, |v_a|] \rangle$ 
66:        $\text{state} := (\text{FOLLOWER}, \text{ACCEPT})$ 

67: upon event  $\langle \text{fifop2p}, \text{Deliver} \mid p, [\text{ACCEPT}, n_L, C] \rangle$  do
68:   if  $\text{state} = (\text{FOLLOWER}, \text{ACCEPT})$  then
69:     if  $n_{\text{prom}} = n_L$  then
70:        $v_a := v_a + \langle C \rangle$ 
71:       trigger  $\langle \text{fifop2p}, \text{Send} \mid p, [\text{ACCEPTED}, n_L, |v_a|] \rangle$ 
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**Algorithm 4** Sequence Paxos (continued)

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72: upon event  $\langle \text{fifop2p}, \text{Deliver} \mid p, [\text{DECIDE}, l, n_L] \rangle$  do
73:   if  $n_{prom} = n_L$  then
74:     while  $l_d < l$  do
75:       trigger  $\langle \text{sc}, \text{Decide} \mid v_a[l_d] \rangle$ 
76:        $l_d := l_d + 1$ 

77: upon event  $\langle \text{sc}, \text{Propose} \mid C \rangle$  do
78:   if  $\text{state} = (\text{LEADER}, \text{PREPARE})$  then
79:      $\text{propCmds} := \text{propCmds} + \langle C \rangle$ 
80:   else if  $\text{state} = (\text{LEADER}, \text{ACCEPT})$  then
81:      $v_a := v_a + \langle C \rangle$ 
82:      $\text{las}[\text{self}] := \text{las}[\text{self}] + 1$ 
83:     for all  $p \in \{p \in \Pi \mid \text{lds}[p] \neq \perp \wedge p \neq \text{self}\}$  do
84:       trigger  $\langle \text{fifop2p}, \text{Send} \mid p, [\text{ACCEPT}, n_L, C] \rangle$ 

85: upon event  $\langle \text{fifop2p}, \text{Deliver} \mid a, [\text{ACCEPTED}, n, m] \rangle$  do
86:   if  $\text{state} = (\text{LEADER}, \text{ACCEPT}) \wedge n = n_L$  then
87:      $\text{las}[a] := m$ 
88:     if  $l_c < m \wedge |\{p \in \Pi \mid \text{las}[p] \geq m\}| \geq \lceil \frac{N+1}{2} \rceil$  then
89:        $l_c := m$ 
90:       for all  $p \in \{p \in \Pi \mid \text{lds}[p] \neq \perp\}$  do
91:         trigger  $\langle \text{fifop2p}, \text{Send} \mid p, [\text{DECIDE}, l_c, n_L] \rangle$ 
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