1 ──────────────────────── MODULE *CCTest* ────────────────────────

Test of *CC* Module

5 EXTENDS *CC*

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Test case: The following histories are from Figure 2 of the *POPL*'2017 paper.

Naming Conventions:

− *ha*: history of Figure 2(a)
− *hasa*: session a of history ha

TODO:

- to add more test cases
- to automatically generate test cases that do or do not satisfy the specs

- consider Section 3.2 of *POPL*'2017
− *ref*: the *MonkeyDB* paper

23 $hasa \triangleq \langle W(\text{"x"}, 1, 1), R(\text{"x"}, 2, 2) \rangle$
24 $hasb \triangleq \langle W(\text{"x"}, 2, 3), R(\text{"x"}, 1, 4) \rangle$
25 $ha \triangleq \{hasa, hasb\}$ *CM* but not *CCv*

27 $hbsa \triangleq \langle W(\text{"z"}, 1, 1), W(\text{"x"}, 1, 2), W(\text{"y"}, 1, 3) \rangle$
28 $hbsb \triangleq \langle W(\text{"x"}, 2, 4), R(\text{"z"}, 0, 5), R(\text{"y"}, 1, 6), R(\text{"x"}, 2, 7) \rangle$
29 $hb \triangleq \{hbsa, hbsb\}$ *CCv* but not *CM*

31 $hcsa \triangleq \langle W(\text{"x"}, 1, 1) \rangle$
32 $hcsb \triangleq \langle W(\text{"x"}, 2, 2), R(\text{"x"}, 1, 3), R(\text{"x"}, 2, 4) \rangle$
33 $hc \triangleq \{hcsa, hcsb\}$ *CC* but not *CM* nor *CCv*

35 $hdsa \triangleq \langle W(\text{"x"}, 1, 1), R(\text{"y"}, 0, 2), W(\text{"y"}, 1, 3), R(\text{"x"}, 1, 4) \rangle$
36 $hdsb \triangleq \langle W(\text{"x"}, 2, 5), R(\text{"y"}, 0, 6), W(\text{"y"}, 2, 7), R(\text{"x"}, 2, 8) \rangle$
37 $hd \triangleq \{hdsa, hdsb\}$ *CC*, *CM*, and *CCv* but no *SC*

39 $hesa \triangleq \langle W(\text{"x"}, 1, 1), W(\text{"y"}, 1, 2) \rangle$
40 $hesb \triangleq \langle R(\text{"y"}, 1, 3), W(\text{"x"}, 2, 4) \rangle$
41 $hesc \triangleq \langle R(\text{"x"}, 2, 5), R(\text{"x"}, 1, 6) \rangle$
42 $he \triangleq \{hesa, hesb, hesc\}$ not *CC* (nor *CM*, nor *CCv*)

44 $all \triangleq \{ha, hb, hc, hd, he\}$

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46 THEOREM *WellFormedTheorem* $\triangleq$ test of well-formedness of histories
47 $\forall h \in all : WellFormed(h)$

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Test of the auxiliary definitions for the axioms

52 $CardOfProgramOrderOfHistory(h) \triangleq$
53 LET $CardOfProgramOrderOfSession(s) \triangleq$
54 IF $Len(s) \leq 1$ THEN 0 ELSE $Sum(1 .. Len(s) - 1)$
55 IN $ReduceSet(\text{LAMBDA } s, x : CardOfProgramOrderOfSession(s) + x, h, 0)$

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57   THEOREM $ProgramOrderCardinalityTheorem$ $\triangleq$ test of $PO(h)$
58      $\forall\, h \in \{ha,\, hb,\, hc,\, hd,\, he\} :$
59         $Cardinality(PO(h)) = CardOfProgramOrderOfHistory(h)$

61   THEOREM $POPastTest$ $\triangleq$ test of $POPast(h,\, o)$
62      $\wedge\, POPast(ha,\, R(\text{``x''},\, 2,\, 2)) = \{W(\text{``x''},\, 1,\, 1)\}$
63      $\wedge\, POPast(hb,\, R(\text{``y''},\, 1,\, 6)) = \{W(\text{``x''},\, 2,\, 4),\, R(\text{``z''},\, 0,\, 5)\}$
64      $\wedge\, POPast(hc,\, W(\text{``x''},\, 2,\, 2)) = \{\}$
65      $\wedge\, POPast(hd,\, R(\text{``x''},\, 1,\, 4)) = \{W(\text{``x''},\, 1,\, 1),\, R(\text{``y''},\, 0,\, 2),\, W(\text{``y''},\, 1,\, 3)\}$
66      $\wedge\, POPast(he,\, W(\text{``x''},\, 2,\, 4)) = \{R(\text{``y''},\, 1,\, 3)\}$

68   THEOREM $CausalPastTest$ $\triangleq$ $TODO$: test of $CausalPast(co,\, o)$
69   FALSE

71   THEOREM $CausalHistTest$ $\triangleq$ $TODO$: test of $CausalHist(co,\, o)$
72   FALSE

74   THEOREM $CausalArbTest$ $\triangleq$ $TODO$: test of $CausalArb(co,\, ar,\, o)$
75   FALSE
76 $\vdash$───

Test of axioms

$TODO$: test of $AxCausalValue$, $AxCausalArb$, etc

82   THEOREM $RWRegSemanticsTest$ $\triangleq$ Test of $RWRegSemanticsTest(seq,\, o)$
83      $seq = \langle\rangle$
84      $\wedge\, RWRegSemantics(\langle\rangle,\, R(\text{``x''},\, InitVal,\, 1))$
85      $\wedge\, RWRegSemantics(\langle\rangle,\, W(\text{``x''},\, 1,\, 1))$
86      $\wedge\, \neg RWRegSemantics(\langle\rangle,\, R(\text{``x''},\, 2,\, 1))$
87   no $W(\text{''x``},\, \_,\, \_)$ in seq
88      $\wedge\, RWRegSemantics(\langle W(\text{``y''},\, 1,\, 1),\, W(\text{``z''},\, 1,\, 2),\, W(\text{``y''},\, 1,\, 3)\rangle,\, R(\text{``x''},\, InitVal,\, 4))$
89      $\wedge\, RWRegSemantics(\langle W(\text{``y''},\, 1,\, 1),\, W(\text{``z''},\, 1,\, 2),\, W(\text{``y''},\, 1,\, 3)\rangle,\, W(\text{``x''},\, 1,\, 4))$
90      $\wedge\, \neg RWRegSemantics(\langle W(\text{``y''},\, 1,\, 1),\, W(\text{``z''},\, 1,\, 2),\, W(\text{``y''},\, 1,\, 3)\rangle,\, R(\text{``x''},\, 1,\, 4))$
91   contains $W(\text{''x``},\, \_,\, \_)$ in seq
92      $\wedge\, RWRegSemantics(\langle W(\text{``x''},\, 1,\, 1),\, W(\text{``y''},\, 1,\, 2),\, W(\text{``x''},\, 2,\, 3),\, W(\text{``z''},\, 1,\, 4)\rangle,\, R(\text{``x''},\, 2,\, 5))$
93      $\wedge\, \neg RWRegSemantics(\langle W(\text{``x''},\, 1,\, 1),\, W(\text{``y''},\, 1,\, 2),\, W(\text{``x''},\, 2,\, 3),\, W(\text{``z''},\, 1,\, 4)\rangle,\, R(\text{``x''},\, 1,\, 5))$
94 $\vdash$───

Test of the definitions of causal consistency

ha: 4; hb: 7; hc: 4; hd: 8; he: 6

100 $CCTest$ $\triangleq$
101      $\wedge$ $PrintT(CC(ha))$
102      $\wedge$ $PrintT(CC(hc))$
103      $\wedge$ $PrintT(\neg CC(he))$
104      $\wedge$ LET sat $\triangleq$ $\{ha,\, hb,\, hc,\, hd\}$
105   IN $\wedge\, \forall\, h \in sat : CC(h)$
106                $\wedge\, \forall\, h \in all \setminus sat : \neg CC(h)$

108    $CCvTest \triangleq$
109        $\land PrintT(\neg CCv(ha))$
110        $\land CCv(hb)$
111        $\land PrintT(\neg CCv(hc))$
112        $\land CCv(hd)$
113        $\land PrintT(\neg CCv(he))$

115   LET $sat \triangleq \{hb,\ hd\}$
116   IN $\land \forall h \in sat:\ CCv(h)$
117         $\land \forall h \in all \setminus sat:\ \neg CCv(h)$
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