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┌──────────────────────── MODULE AbsJupiter ────────────────────────┐
Abstract Jupiter, inspired by the COT algorithm proposed by Sun and Sun. See their paper
published on TPDS′2009.
EXTENDS JupiterSerial
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VARIABLES
    ds,        ds[r]: document state at replica r ∈ Replica
    copss      copss[r]: the state space (i.e., a set) of Cops maintained at replia r ∈ Replica

vars ≜ ⟨intVars, ctxVars, serialVars, ds, copss⟩
├───────────────────────────────────────────────────────────────────┤
TypeOK ≜
    ∧  TypeOKInt
    ∧  TypeOKCtx
    ∧  TypeOKSerial
    ∧  Comm(Cop)!TypeOK
    ∧  ds ∈ [Replica → SUBSET Oid]
    ∧  copss ∈ [Replica → SUBSET Cop]
├───────────────────────────────────────────────────────────────────┤
Init ≜
    ∧ InitInt
    ∧ InitCtx
    ∧ InitSerial
    ∧ Comm(Cop)!Init
    ∧ ds = [r ∈ Replica ↦ {}]
    ∧ copss = [r ∈ Replica ↦ {}]
├───────────────────────────────────────────────────────────────────┤
RECURSIVE xForm(_, _)
xForm(cop, r) ≜
    LET ctxDiff ≜ ds[r] \ cop.ctx   THEOREM : cop.ctx ⊆ ds[r]
        RECURSIVE xFormHelper(_, _, _)
         xFormHelper(coph, ctxDiffh, copssr) ≜     'h' stands for “helper”
            IF ctxDiffh = {}
             THEN ⟨coph, copssr⟩
             ELSE LET foph ≜ CHOOSE op ∈ ctxDiffh :   the first op (specifically, oid) in serial
                                   ∀ opprime ∈ ctxDiffh :
                                      opprime ≠ op ⇒ tb(op, opprime, serial[r])
                      fcophDict ≜ {op ∈ copssr : op.oid = foph ∧ op.ctx = coph.ctx}
                      fcoph ≜ CHOOSE op ∈ fcophDict : TRUE  THEOREM : Cardinality(fophDict) = 1
                      cophx ≜ COT(coph, fcoph)
                       fcophx ≜ COT(fcoph, coph)
                  IN  xFormHelper(cophx, ctxDiffh \ {foph}, copssr ∪ {cophx, fcophx})
     IN  xFormHelper(cop, ctxDiff, copss[r])

Perform(cop, r) ≜
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      LET $xform \triangleq xForm(cop, r)$   $\langle xcop, xcopss \rangle$
          $xcop \triangleq xform[1]$
           $xcopssr \triangleq xform[2]$
       IN  $\land state' = [state$ EXCEPT $![r] = Apply(xcop.op, @)]$
           $\land ds' = [ds$ EXCEPT $![r] = @ \cup \{cop.oid\}]$
           $\land copss' = [copss$ EXCEPT $![r] = xcopssr \cup \{cop\}]$
|------------------------------------------------------------------------|
Client $c \in Client$ issues an operation $op$.
$DoOp(c, op) \triangleq$   $op$: the raw operation generated by the client $c \in Client$
        $\land$ LET $cop \triangleq [op \mapsto op, oid \mapsto [c \mapsto c, seq \mapsto cseq'[c]], ctx \mapsto ds[c]]$
             IN  $\land Perform(cop, c)$
                 $\land Comm(Cop)!CSend(cop)$

$DoIns(c) \triangleq$
    $\exists ins \in \{op \in Ins : op.pos \in 1 \,..\, (Len(state[c]) + 1) \land op.ch \in chins \land op.pr = Priority[c]\}$ :
        $\land DoOp(c, ins)$
        $\land chins' = chins \setminus \{ins.ch\}$   We assume that all inserted elements are unique.

$DoDel(c) \triangleq$
    $\exists del \in \{op \in Del : op.pos \in 1 \,..\, Len(state[c])\}$ :
        $\land DoOp(c, del)$
        $\land$ UNCHANGED $chins$

$Do(c) \triangleq$
        $\land DoCtx(c)$
        $\land DoSerial(c)$
        $\land \lor DoIns(c)$
           $\lor DoDel(c)$
|------------------------------------------------------------------------|
$Rev(c) \triangleq$
        $\land Comm(Cop)!CRev(c)$
        $\land Perform(Head(cincoming[c]), c)$
        $\land RevSerial(c)$
        $\land RevCtx(c)$
        $\land$ UNCHANGED $chins$
|------------------------------------------------------------------------|
$SRev \triangleq$
      $\land Comm(Cop)!SRev$
      $\land$ LET $cop \triangleq Head(sincoming)$
           IN  $\land Perform(cop, Server)$
               $\land Comm(Cop)!SSendSame(cop.oid.c, cop)$
      $\land SRevSerial$
      $\land SRevCtx$
      $\land$ UNCHANGED $chins$
|------------------------------------------------------------------------|
$Next \triangleq$
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$\qquad \lor \exists\, c \in \mathit{Client} : \mathit{Do}(c) \lor \mathit{Rev}(c)$

$\qquad \lor\, \mathit{SRev}$

$\mathit{Fairness} \;\triangleq$

$\qquad \mathrm{WF}_{\mathit{vars}}(\mathit{SRev} \lor \exists\, c \in \mathit{Client} : \mathit{Rev}(c))$

$\mathit{Spec} \;\triangleq\; \mathit{Init} \land \Box[\mathit{Next}]_{\mathit{vars}} \;\; \land \mathit{Fairness}$

$\mathit{Compactness} \;\triangleq$

$\qquad \mathit{Comm}(\mathit{Cop})!\mathit{EmptyChannel} \Rightarrow \mathit{Cardinality}(\mathit{Range}(\mathit{copss})) = 1$

THEOREM $\mathit{Spec} \Rightarrow \mathit{Compactness}$

* Modification History

* Last modified Sat *Dec* 15 17:23:35 *CST* 2018 by *hengxin*

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