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1  ---------- MODULE StateSpace ----------
   The graph representation of n-ary ordered state spaces and 2D state spaces used in CJupiter and XJupiter, respectively.
6  EXTENDS JupiterCtx, GraphsUtil
7  ----------
   A state space is a directed graph with labeled edges. Each node is characterized by its context, a set of operations. Each edge is labeled with an operation.
13 IsSS(G) ≜
14       ∧ IsGraph(G)
15       ∧ G.node ⊆ (SUBSET Oid)
16       ∧ G.edge ⊆ [from : G.node, to : G.node, cop : Cop]

18 EmptySS ≜ EmptyGraph
   Locate the node in a state space that matches the context ctx of cop.
22 Locate(cop, ss) ≜ CHOOSE n ∈ ss.node : n = cop.ctx
   Do transformation on state space. Return the extra state space.
27 xFormSS(cop, copprime) ≜
28     LET u ≜ cop.ctx
29         v ≜ u ∪ {cop.oid}
30         uprime ≜ u ∪ {copprime.oid}
31         vprime ≜ u ∪ {cop.oid, copprime.oid}
32         cop2copprime ≜ COT(cop, copprime)
33         copprime2cop ≜ COT(copprime, cop)
34      IN [node ↦ {u, v, uprime, vprime},
35          edge ↦ {[from ↦ u, to ↦ v, cop ↦ cop],
36                  [from ↦ u, to ↦ uprime, cop ↦ copprime],
37                  [from ↦ v, to ↦ vprime, cop ↦ copprime2cop],
38                  [from ↦ uprime, to ↦ vprime, cop ↦ cop2copprime]}]
   Transform cop against cops (a sequence of cops) on state space. Return the extra state space.
43 xFormCopCopsSS(cop, cops) ≜
44     LET RECURSIVE xFormCopCopsSSHelper(_, _, _)
45         xFormCopCopsSSHelper(coph, copsh, xss) ≜   xss: the eXtra state space
46             LET u ≜ coph.ctx
47                 v ≜ u ∪ {coph.oid}
48                 uvSS ≜ [node ↦ {u, v}, edge ↦ {[from ↦ u, to ↦ v, cop ↦ coph]}]
49             IN IF copsh = ⟨⟩ THEN [lss ↦ uvSS, xss ↦ xss ⊕ uvSS]
50                ELSE LET copprimeh ≜ Head(copsh)
51                         uprime ≜ u ∪ {copprimeh.oid}
52                         vprime ≜ u ∪ {coph.oid, copprimeh.oid}
53                         coph2copprimeh ≜ COT(coph, copprimeh)
54                         copprimeh2coph ≜ COT(copprimeh, coph)
55                     IN xFormCopCopsSSHelper(coph2copprimeh, Tail(copsh),
56                         xss ⊕ [node ↦ {u, v},
57                                edge ↦ {[from ↦ u, to ↦ v, cop ↦ coph],
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                                                    [from ↦ u, to ↦ uprime, cop ↦ copprimeh],
                                                    [from ↦ v, to ↦ vprime, cop ↦ copprimeh2coph]}])
    IN  xFormCopCopsSSHelper(cop, cops, EmptySS)
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* Modification History
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