MODULE *Digraph*

$IsDigraph(G) \triangleq$ G is a record with *node* and *edge* fields
$\quad \land\ G.node \subseteq (\text{SUBSET } Oid)$ each node represents a document state
$\quad \land\ G.edge \subseteq [from : G.node,\ to : G.node,\ cop : Cop]$
$EmptyGraph \triangleq [node \mapsto \{\{\}\},\ edge \mapsto \{\}]$

$g \oplus h \triangleq [node \mapsto g.node \cup h.node,\ edge \mapsto g.edge \cup h.edge]$

$xForm(NextEdge(\_, \_, \_),\ r,\ cop,\ g) \triangleq$ Transform *cop* in g at replica r
$\quad \text{LET } u \triangleq \text{CHOOSE } n \in g.node : n = cop.ctx \quad v \triangleq u \cup \{cop.oid\}$
$\qquad xFormHelper(uh,\ vh,\ coph,\ gh) \triangleq$
$\qquad\quad \text{IF } uh = ds[r] \text{ THEN } [xcop \mapsto coph,\ xg \mapsto gh,$
$\qquad\qquad lg \mapsto [node \mapsto \{vh\},$
$\qquad\qquad edge \mapsto \{[from \mapsto uh,\ to \mapsto vh,\ cop \mapsto coph]\}]]$
$\qquad\quad \text{ELSE LET } e \triangleq NextEdge(r,\ uh,\ g)$ specific to *CJupiter* and *XJupiter*
$\qquad\qquad ecop \triangleq e.cop \quad eu \triangleq e.to \quad ev \triangleq vh \cup \{ecop.oid\}$
$\qquad\qquad coph2ecop \triangleq COT(coph,\ ecop)$
$\qquad\qquad ecop2coph \triangleq COT(ecop,\ coph)$
$\qquad\qquad \text{IN } xFormHelper(eu,\ ev,\ coph2ecop,$
$\qquad\qquad gh \oplus [node \mapsto \{ev\},$
$\qquad\qquad edge \mapsto \{[from \mapsto vh,\ to \mapsto ev,\ cop \mapsto ecop2coph],$
$\qquad\qquad [from \mapsto eu,\ to \mapsto ev,\ cop \mapsto coph2ecop]\}])$
$\quad \text{IN } xFormHelper(u,\ v,\ cop,\ [node \mapsto \{v\},$
$\qquad\qquad edge \mapsto \{[from \mapsto u,\ to \mapsto v,\ cop \mapsto cop]\}])$