

Decomposition-based Verification of Global Compliance in Process Choreographies

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Appendix

Proof (Chaining Transitivity). Let A, B, C be three activities or interactions such as $\boxed{A} \rightarrow \boxed{B} \wedge \boxed{A} \dashrightarrow \boxed{C} \wedge \boxed{C} \dashrightarrow \boxed{B}$: if A and B occur then C should occur in between.

Let Let M, E, F be three activities or interactions such as

- (1) $\boxed{A} \rightarrow \boxed{M} \wedge \boxed{A} \dashrightarrow \boxed{E}$
- (2) $\boxed{M} \rightarrow \boxed{B} \wedge \boxed{F} \dashrightarrow \boxed{B}$
- (3) $\boxed{E} \rightarrow \boxed{F} \wedge \boxed{E} \dashrightarrow \boxed{C} \wedge \boxed{C} \dashrightarrow \boxed{F}$

Then, (1) \wedge (2) \wedge (3)

$$\Leftrightarrow \forall a \forall m : \left((x(a, A) \wedge x(m, M) \wedge a < m) \rightarrow \exists e : (x(e, E) \wedge a < e) \right) \wedge$$

$$\forall m \forall b : \left((x(m, M) \wedge x(b, B) \wedge m < b) \rightarrow \exists f : (x(f, F) \wedge f < b) \right) \wedge$$

$$\forall e \forall f : \left((x(e, E) \wedge x(f, F) \wedge e < f) \rightarrow \exists c : (x(c, C) \wedge e < c \wedge c < f) \right)$$

$$\Leftrightarrow \forall a \forall m \forall b : \left((x(a, A) \wedge x(m, M) \wedge x(b, B) \wedge a < m \wedge m < b) \rightarrow (\exists e \exists f ((x(e, E) \wedge x(f, F) \wedge a < e \wedge f < b)) \right) \wedge$$

$$\forall e \forall f : \left((x(e, E) \wedge x(f, F) \wedge e < f) \rightarrow \exists c : (x(c, C) \wedge e < c \wedge c < f) \right)$$

$$(\text{using Theorem 1}) \Leftrightarrow \forall a \forall b : \left((x(a, A) \wedge x(b, B) \wedge a < b) \rightarrow \exists e \exists f : (x(e, E) \wedge x(f, F) \wedge a < e \wedge f < b) \right) \wedge$$

$$\forall e \forall f : \left((x(e, E) \wedge x(f, F) \wedge e < f) \rightarrow \exists c : (x(c, C) \wedge e < c \wedge c < f) \right)$$

$$\Rightarrow \forall a \forall b : \left((x(a, A) \wedge x(b, B) \wedge a < b) \rightarrow \exists e \exists f \exists c : (x(e, E) \wedge x(f, F) \wedge x(c, C) \wedge a < e \wedge e < c \wedge c < f \wedge f < b) \right)$$

$$\Rightarrow \forall a \forall b : \left((x(a, A) \wedge x(b, B) \wedge a < b) \rightarrow \exists c : (x(c, C) \wedge a < c \wedge c < b) \right)$$

Proof (Requires transitivity). Let A, B be two activities or interactions such as $\boxed{A} \dashrightarrow \boxed{B} \vee \boxed{B} \dashrightarrow \boxed{A}$: if A occurs then B should occur (before or after, $\exists A \rightarrow \exists B$):

Let A, B, M be three activities or interactions such as $(\boxed{A} \dashrightarrow \boxed{M} \vee \boxed{M} \dashrightarrow \boxed{A}) \wedge (\boxed{M} \dashrightarrow \boxed{B} \vee \boxed{B} \dashrightarrow \boxed{M})$. Then

$$:\Leftrightarrow \exists a : \left(x(a, A) \rightarrow \exists m : x(m, M) \right) \wedge \exists m : \left(x(m, M) \rightarrow \exists b : x(b, B) \right)$$

$$\Leftrightarrow \exists a \left(x(a, A) \rightarrow \exists b : x(b, B) \right)$$