

# BFO 2020 Occurrent Mereology Axioms

Occurrent part of and has occurrent part are inverse relations [yvi-1]

$$\forall a,b(\text{occurrentPartOf}(a,b) \leftrightarrow \text{hasOccurrentPart}(b,a))$$

Proper occurrent part of and has proper occurrent part are inverse relations [wim-1]

$$\forall a,b(\text{properOccurrentPartOf}(a,b) \leftrightarrow \text{hasProperOccurrentPart}(b,a))$$

Occurrent part of is reflexive [hbj-1]

$$\forall a(\exists t \text{instanceOf}(a,\text{occurrent},t) \rightarrow \text{occurrentPartOf}(a,a))$$

Occurrent part of is antisymmetric [xlu-1]

$$\forall a,b(\text{occurrentPartOf}(a,b) \wedge \text{occurrentPartOf}(b,a) \rightarrow a=b)$$

A proper occurrent part of b means a is an occurrent part of b and a is not the same as b [okr-1]

$$\forall x,y(\text{properOccurrentPartOf}(x,y) \leftrightarrow \text{occurrentPartOf}(x,y) \wedge x \neq y)$$

Occurrent part of is transitive [kad-1]

$$\forall a,b,c(\text{occurrentPartOf}(a,b) \wedge \text{occurrentPartOf}(b,c) \rightarrow \text{occurrentPartOf}(a,c))$$

If one occurrent is part of another, then the temporal region on which the former projects is a part of the temporal region on which the latter projects [ybr-1]

$$\forall o1,o2(\text{occurrentPartOf}(o1,o2) \rightarrow \forall t(\text{existsAt}(o1,t) \rightarrow \text{existsAt}(o2,t)))$$

Occurrent part of has domain occurrent and range occurrent [zmr-1]

$$\forall a,b(\text{occurrentPartOf}(a,b) \rightarrow \exists t \text{instanceOf}(a,\text{occurrent},t) \wedge \exists t \text{instanceOf}(b,\text{occurrent},t))$$

If a occurrent part of b then if a is an instance of process then b is an instance of process [csk-1]

$$\forall p,q(\text{occurrentPartOf}(p,q) \rightarrow (\exists t \text{instanceOf}(p,\text{process},t) \rightarrow \exists t \text{instanceOf}(q,\text{process},t)))$$

Proper temporal part of has domain occurrent and range occurrent [ees-1]

$$\begin{aligned} \forall a,b(\text{properTemporalPartOf}(a,b) \\ \rightarrow \exists t \text{instanceOf}(a,\text{occurrent},t) \wedge \exists t \text{instanceOf}(b,\text{occurrent},t)) \end{aligned}$$

Proper occurrent part of has domain occurrent and range occurrent [yhc-1]

$$\begin{aligned} \forall a,b(\text{properOccurrentPartOf}(a,b) \\ \rightarrow \exists t \text{instanceOf}(a,\text{occurrent},t) \wedge \exists t \text{instanceOf}(b,\text{occurrent},t)) \end{aligned}$$

Every process has a process boundary [aff-1]

$$\begin{aligned} \forall p(\exists t \text{instanceOf}(p,\text{process},t) \\ \rightarrow \exists pb,t(\text{instanceOf}(pb,\text{processBoundary},t) \wedge \text{occurrentPartOf}(pb,p))) \end{aligned}$$

If a occurrent part of b then if a is an instance of temporal region then b is an instance of temporal region, and vice versa [gjl-1]

$$\begin{aligned} \forall p,q(\text{occurrentPartOf}(p,q) \\ \rightarrow (\exists t \text{instanceOf}(p,\text{temporalRegion},t) \leftrightarrow \exists t \text{instanceOf}(q,\text{temporalRegion},t))) \end{aligned}$$

If a has occurrent part b then if a is an instance of process boundary then b is an instance of process boundary [hdk-1]

$$\begin{aligned} \forall p,q(\text{hasOccurrentPart}(p,q) \\ \rightarrow (\exists t \text{instanceOf}(p,\text{processBoundary},t) \rightarrow \exists t \text{instanceOf}(q,\text{processBoundary},t))) \end{aligned}$$

If a occurrent part of b then if a is an instance of spatiotemporal region then b is an instance of spatiotemporal region, and vice versa [myl-1]

$$\begin{aligned} \forall p,q(\text{occurrentPartOf}(p,q) \\ \rightarrow (\exists t \text{instanceOf}(p,\text{spatiotemporalRegion},t) \\ \leftrightarrow \exists t \text{instanceOf}(q,\text{spatiotemporalRegion},t))) \end{aligned}$$

Definition of temporal part for temporal regions [cmv-1]

$$\begin{aligned} \forall b,c(\exists t \text{instanceOf}(b,\text{temporalRegion},t) \wedge \exists t \text{instanceOf}(c,\text{temporalRegion},t) \\ \rightarrow (\text{temporalPartOf}(b,c) \leftrightarrow \text{occurrentPartOf}(b,c))) \end{aligned}$$

If a has occurrent part b then if a is an instance of process then b is an instance of process or process boundary [ccz-1]

$$\begin{aligned} &\forall p,q (\text{hasOccurrentPart}(p,q) \\ &\rightarrow (\exists t \text{instanceOf}(p,\text{process},t) \\ &\rightarrow \exists t (\text{instanceOf}(q,\text{process},t) \vee \text{instanceOf}(q,\text{processBoundary},t)))) \end{aligned}$$

If a occurrent part of b then if a is an instance of process boundary then b is an instance of process or process boundary [ptm-1]

$$\begin{aligned} &\forall p,q (\text{occurentPartOf}(p,q) \\ &\rightarrow (\exists t \text{instanceOf}(p,\text{processBoundary},t) \\ &\rightarrow \exists t (\text{instanceOf}(q,\text{process},t) \vee \text{instanceOf}(q,\text{processBoundary},t)))) \end{aligned}$$

A process boundary is any temporal part of a process that has no proper temporal parts. [esh-1]

$$\begin{aligned} &\forall pb (\exists t \text{instanceOf}(pb,\text{processBoundary},t) \\ &\leftrightarrow (\exists p (\text{temporalPartOf}(pb,p) \wedge \exists t \text{instanceOf}(p,\text{process},t))) \\ &\wedge (\exists t (\text{occupiesTemporalRegion}(pb,t) \wedge \text{instanceOf}(t,\text{temporalInstant},t)))) \end{aligned}$$

Occurrent part of has a unique product [hpc-1]

$$\begin{aligned} &\forall x,y (\exists t (\text{instanceOf}(x,\text{occurent},t) \wedge \text{instanceOf}(y,\text{occurent},t) \\ &\wedge \text{instanceOf}(t,\text{temporalRegion},t)) \\ &\rightarrow (\exists w (\text{occurentPartOf}(w,x) \wedge \text{occurentPartOf}(w,y)) \\ &\rightarrow \exists z (\forall w (\text{occurentPartOf}(w,z) \leftrightarrow \text{occurentPartOf}(w,x) \wedge \text{occurentPartOf}(w,y)))))) \end{aligned}$$

At least one process boundary needs to be at the first or last instant of the process it bounds [qsp-1]

$$\begin{aligned} &\forall p (\exists tp \text{instanceOf}(p,\text{process},tp) \\ &\rightarrow \exists pb,tb,tp (\text{occupiesTemporalRegion}(p,tp) \wedge \text{occurentPartOf}(pb,p) \\ &\wedge \text{occupiesTemporalRegion}(pb,tb) \wedge \text{instanceOf}(pb,\text{processBoundary},tb) \\ &\wedge (\exists ltp,ftp (\text{hasFirstInstant}(tp,ftp) \wedge \text{hasLastInstant}(tp,ltp) \\ &\wedge (tb=ftp \vee tb=ltp)))))) \end{aligned}$$

B temporal part c (both spatiotemporal regions) iff b temporal projection is part of c's temporal projection, and for all parts of b's existence, if it spatially projects onto s at that time, then so does c [eom-1]

$$\begin{aligned} &\forall b,c (\exists t \text{instanceOf}(b,\text{spatiotemporalRegion},t) \wedge \exists t \text{instanceOf}(c,\text{spatiotemporalRegion},t) \\ &\rightarrow (\text{temporalPartOf}(b,c) \\ &\leftrightarrow \exists tb,tc (\text{temporallyProjectsOnto}(b,tb) \wedge \text{temporallyProjectsOnto}(c,tc) \\ &\wedge \text{occurentPartOf}(tb,tc) \\ &\wedge (\forall tp (\text{occurentPartOf}(tp,tb) \wedge \exists s \text{spatiallyProjectsOnto}(b,s,tp) \\ &\rightarrow \exists s (\text{spatiallyProjectsOnto}(b,s,tp) \\ &\wedge \text{spatiallyProjectsOnto}(c,s,tp))))))) \end{aligned}$$

Two spatiotemporal regions are parts when they are temporal parts and their spatial projects are always parts [txf-1]

$$\begin{aligned} &\forall st1,st2 (\exists t \text{instanceOf}(st1,\text{spatiotemporalRegion},t) \\ &\wedge \exists t \text{instanceOf}(st2,\text{spatiotemporalRegion},t) \\ &\rightarrow (\text{occurentPartOf}(st1,st2) \\ &\leftrightarrow (\exists t1,t2 (\text{temporallyProjectsOnto}(st1,t1) \wedge \text{temporallyProjectsOnto}(st2,t2) \\ &\wedge \text{temporalPartOf}(t1,t2))) \\ &\wedge (\forall t (\text{existsAt}(st1,t) \\ &\rightarrow \exists s1,s2,tp (\text{temporalPartOf}(tp,t) \wedge \text{spatiallyProjectsOnto}(st1,s1,tp) \\ &\wedge \text{spatiallyProjectsOnto}(st2,s2,tp) \\ &\wedge \text{continuantPartOf}(s1,s2,tp)))))) \end{aligned}$$
