

BFO 2020 Specific Dependency Axioms

(1) If s depends on c at t then s and c do not share common parts (s, c continuants)

$$\forall s, c (\text{specificallyDependsOn}(s, c) \rightarrow \neg (\exists w, t (\text{continuantPartOf}(w, s, t) \wedge \text{continuantPartOf}(w, c, t))))$$

(2) Specifically depends on and specifically depended on by are inverse relations

$$\forall a, b (\text{specificallyDependsOn}(a, b) \leftrightarrow \text{specificallyDependedOnBy}(b, a))$$

(3) Inheres in has domain specifically dependent continuant and range independent continuant but not spatial region

$$\begin{aligned} \forall a, b (\text{inheresIn}(a, b) &\rightarrow \exists t \text{instanceOf}(a, \text{specificallyDependentContinuant}, t) \\ &\wedge (\exists t (\text{instanceOf}(b, \text{independentContinuant}, t) \wedge \neg \text{instanceOf}(b, \text{spatialRegion}, t)))) \end{aligned}$$

(4) Has material basis and material basis of are inverse relations

$$\forall t, a, b (\text{hasMaterialBasis}(a, b, t) \leftrightarrow \text{materialBasisOf}(b, a, t))$$

(5) DEFINITION: b is a relational quality = Def. b is a quality and there exists distinct c and d such that at all times t , b inheres in c at t if and only b specifically depends on d at t .

$$\begin{aligned} \forall b (\exists t \text{instanceOf}(b, \text{relationalQuality}, t) &\leftrightarrow (\exists c, d (c \neq d \wedge \text{inheresIn}(b, c) \wedge \text{specificallyDependsOn}(b, d))) \\ &\wedge \exists t \text{instanceOf}(b, \text{quality}, t)) \end{aligned}$$

(6) Inheres in and bearer of are inverse relations

$$\forall a, b (\text{inheresIn}(a, b) \leftrightarrow \text{bearerOf}(b, a))$$

(7) Specifically depends on has domain specifically dependent continuant and range specifically dependent continuant or independent continuant but not spatial region

$$\begin{aligned} \forall a, b (\text{specificallyDependsOn}(a, b) &\rightarrow \exists t \text{instanceOf}(a, \text{specificallyDependentContinuant}, t) \\ &\wedge (\exists t (\text{instanceOf}(b, \text{specificallyDependentContinuant}, t) \\ &\vee (\text{instanceOf}(b, \text{independentContinuant}, t) \\ &\wedge \neg \text{instanceOf}(b, \text{spatialRegion}, t)))))) \end{aligned}$$

(8) A role exists at least at the beginning of the realization process

$$\begin{aligned} \forall r, p (\text{realizes}(p, r) &\rightarrow \exists \text{proct, first} (\text{occupiesTemporalRegion}(p, \text{proct}) \wedge \text{hasFirstInstant}(\text{proct}, \text{first}) \\ &\wedge \text{existsAt}(r, \text{first}))) \end{aligned}$$

(9) Has material basis is time indexed and has domain: disposition and range: material entity

$$\begin{aligned} \forall a, b, t (\text{hasMaterialBasis}(a, b, t) &\rightarrow \text{instanceOf}(a, \text{disposition}, t) \wedge \text{instanceOf}(b, \text{materialEntity}, t) \\ &\wedge \text{instanceOf}(t, \text{temporalRegion}, t)) \end{aligned}$$

(10) Realizes has domain process and range realizable entity

$$\forall a, b (\text{realizes}(a, b) \rightarrow \exists t \text{instanceOf}(a, \text{process}, t) \wedge \exists t \text{instanceOf}(b, \text{realizableEntity}, t))$$

(11) A inheres in b at t = Def. a is a specifically dependent continuant and b is an independent continuant that is not a spatial region and a depends on b at t .

$$\begin{aligned} \forall a, b (\text{inheresIn}(a, b) &\leftrightarrow \text{specificallyDependsOn}(a, b) \\ &\wedge (\exists t (\text{instanceOf}(a, \text{specificallyDependentContinuant}, t) \\ &\wedge \text{instanceOf}(b, \text{independentContinuant}, t) \wedge \neg \text{instanceOf}(b, \text{spatialRegion}, t)))) \end{aligned}$$

(12) When a role is realized the bearer of the role participates in the realization process

$$\forall r, p, b (\text{realizes}(p, r) \wedge \text{inheresIn}(r, b) \rightarrow \exists t \text{participatesIn}(b, p, t))$$

(13) The material basis of a disposition is part of the bearer of the disposition

$$\forall m,d,b (\exists t \text{instanceOf}(m,\text{materialEntity},t) \wedge \exists t \text{instanceOf}(d,\text{disposition},t) \\ \wedge \exists t \text{instanceOf}(b,\text{materialEntity},t) \wedge \text{inheresIn}(d,b) \\ \rightarrow \forall t (\text{hasMaterialBasis}(d,m,t) \rightarrow \text{continuantPartOf}(m,b,t)))$$

(14) Specifically depends on is transitive

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

(15) Has material basis is disjunctive on third argument, a temporal region

$$\forall p,q,r,s (\text{hasMaterialBasis}(p,q,r) \wedge \text{temporalPartOf}(s,r) \rightarrow \text{hasMaterialBasis}(p,q,s))$$

(16) Definition of specifically dependent continuant.

$$\forall s (\exists t \text{instanceOf}(s,\text{specificallyDependentContinuant},t) \\ \leftrightarrow \exists c,t (\text{instanceOf}(s,\text{continuant},t) \wedge \text{instanceOf}(c,\text{independentContinuant},t) \\ \wedge \neg \text{instanceOf}(c,\text{spatialRegion},t) \wedge \text{specificallyDependsOn}(s,c)))$$

(17) If x s depends on y then there's at least one time when they both exist

$$\forall s,c (\text{specificallyDependsOn}(s,c) \\ \rightarrow (\exists t (\text{existsAt}(s,t) \wedge \text{existsAt}(c,t))) \wedge (\forall t (\text{existsAt}(s,t) \rightarrow \text{existsAt}(c,t))))$$

(18) Realizes and has realization are inverse relations

$$\forall a,b (\text{realizes}(a,b) \leftrightarrow \text{hasRealization}(b,a))$$

(19) At every time a specific dependent s participates in a process p there's a part of that time, during which there's an independent continuant that s s depends on, and that participates in p at that time

$$\forall sdc,p,t (\text{instanceOf}(sdc,\text{specificallyDependentContinuant},t) \wedge \text{participatesIn}(sdc,p,t) \\ \rightarrow \exists tp,ic (\text{instanceOf}(tp,\text{temporalRegion},tp) \\ \wedge \text{instanceOf}(ic,\text{independentContinuant},tp) \\ \wedge \neg \text{instanceOf}(ic,\text{spatialRegion},tp) \wedge \text{specificallyDependsOn}(sdc,ic) \\ \wedge \text{participatesIn}(ic,p,tp)))$$