BFO 2020 Material Entity Axioms

(1) I is an immaterial entity = Def. i is an independent continuant that has no material entities as parts.
\[ ∀i,t \ (\text{instanceOf}(i,\text{immaterialEntity},t) \leftrightarrow \text{instanceOf}(i,\text{independentContinuant},t) \land \neg (∃m \ (\text{instanceOf}(m,\text{materialEntity},t) \land \text{continuantPartOf}(m,i,t)))) \]

(2) Member part of is disjunctive on third argument, a temporal region
\[ ∀p,q,r,s (\text{memberPartOf}(p,q,r) \land \text{temporalPartOf}(s,r) \rightarrow \text{memberPartOf}(p,q,s)) \]

(3) If a material entity has a proper part, then at least one of its proper parts is not a material entity
\[ ∀m,t \ (\text{instanceOf}(m,\text{materialEntity},t) \land (∃mp (\text{continuantPartOf}(mp,m,t) \land mp \neq m)) \rightarrow (∃mp (mp \neq m \land \text{continuantPartOf}(mp,m,t) \land \neg \text{instanceOf}(mp,\text{immaterialEntity},t)))) \]

(4) Any continuant that doesn’t s depend or g depend on something is an independent continuant
\[ ∀c1 \ (∃t \ \text{instanceOf}(c1,\text{independentContinuant},t) \leftrightarrow (∃t \ \text{instanceOf}(c1,\text{continuant},t) \land \neg (∃c2,t \ (\text{specificallyDependsOn}(c1,c2) \lor \text{genericallyDependsOn}(c1,c2,t)))) \]

(5) A fiat object part =def a proper part of an object
\[ ∀f,t \ (\text{instanceOf}(f,\text{fiatObjectPart},t) \leftrightarrow (∃o \ (\text{instanceOf}(o,\text{object},t) \land \text{properContinuantPartOf}(f,o,t) \land \neg \text{instanceOf}(f,\text{immaterialEntity},t))) \]

(6) An object aggregate has more than one member at least one time
\[ ∀ag \ (∃t \ \text{instanceOf}(ag,\text{objectAggregate},t) \rightarrow (∃o1,o2,t \ (o1 \neq o2 \land \text{instanceOf}(o1,\text{object},t) \land \text{memberPartOf}(o1,ag,t) \land \text{instanceOf}(o2,\text{object},t) \land \text{memberPartOf}(o2,ag,t))) \]

(7) Member part of is time indexed and has domain: object and range: object aggregate
\[ ∀a,b,t \ (\text{memberPartOf}(a,b,t) \rightarrow \text{instanceOf}(a,\text{object},t) \land \text{instanceOf}(b,\text{objectAggregate},t) \land \text{instanceOf}(t,\text{temporalRegion},t)) \]

(8) Member part of and has member part are inverse relations
\[ ∀t,a,b \ (\text{memberPartOf}(a,b,t) \leftrightarrow \text{hasMemberPart}(b,a,t)) \]

(9) An object aggregate always has at least one member
\[ ∀ag,t \ (\text{instanceOf}(ag,\text{objectAggregate},t) \rightarrow (∃o1 \ (\text{instanceOf}(o1,\text{object},t) \land \text{memberPartOf}(o1,ag,t)))) \]

(10) An object aggregate has member parts only disjoint objects
\[ ∀b,c,t \ (\text{memberPartOf}(b,c,t) \leftrightarrow \text{instanceOf}(b,\text{object},t) \land \text{instanceOf}(c,\text{objectAggregate},t) \land \text{properContinuantPartOf}(b,c,t) \land (∃d (\text{memberPartOf}(d,b,c,t) \rightarrow \neg (b=d \lor \neg (∃z (\text{continuantPartOf}(z,b,t) \land \text{continuantPartOf}(z,d,t))))))) \]

(11) All parts of an aggregate overlap some member
\[ ∀t,b,x \ (\text{properContinuantPartOf}(x,b,t) \land \text{instanceOf}(b,\text{objectAggregate},t) \rightarrow (∃o (\text{memberPartOf}(o,b,t) \land (∃z (\text{continuantPartOf}(z,x,t) \land \text{continuantPartOf}(z,o,t)))))) \]

Alan Ruttenberg, December 5, 2019

This work is licensed under a Creative Commons “Attribution 4.0 International” license.