

# BFO 2020 Material Entity Axioms

Member part of and has member part are inverse relations [jrm-1]

$$\forall t,a,b (\text{memberPartOf}(a,b,t) \leftrightarrow \text{hasMemberPart}(b,a,t))$$

Member part of is disjunctive on third argument, a temporal region [yip-1]

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

An object aggregate always has at least one member [uhs-1]

$$\begin{aligned} &\forall ag,t (\text{instanceOf}(ag,\text{objectAggregate},t) \\ &\quad \rightarrow \exists o1 (\text{instanceOf}(o1,\text{object},t) \wedge \text{memberPartOf}(o1,ag,t))) \end{aligned}$$

Member part of is time indexed and has domain: object and range: object aggregate [dvq-1]

$$\begin{aligned} &\forall a,b,t (\text{memberPartOf}(a,b,t) \\ &\quad \rightarrow \text{instanceOf}(a,\text{object},t) \wedge \text{instanceOf}(b,\text{objectAggregate},t) \\ &\quad \wedge \text{instanceOf}(t,\text{temporalRegion},t)) \end{aligned}$$

A fiat object part =def a proper part of an object [yir-1]

$$\begin{aligned} &\forall f,t (\text{instanceOf}(f,\text{fiatObjectPart},t) \\ &\quad \leftrightarrow \exists o (\text{instanceOf}(o,\text{object},t) \wedge \text{properContinuantPartOf}(f,o,t) \\ &\quad \wedge \neg \text{instanceOf}(f,\text{immaterialEntity},t))) \end{aligned}$$

I is an immaterial entity = Def. i is an independent continuant that has no material entities as parts. [udu-1]

$$\begin{aligned} &\forall i,t (\text{instanceOf}(i,\text{immaterialEntity},t) \\ &\quad \leftrightarrow \text{instanceOf}(i,\text{independentContinuant},t) \\ &\quad \wedge \neg (\exists m (\text{instanceOf}(m,\text{materialEntity},t) \wedge \text{continuantPartOf}(m,i,t)))) \end{aligned}$$

Any continuant that doesn't depend or g depend on something is an independent continuant [ilw-1]

$$\begin{aligned} &\forall c1 (\exists t \text{instanceOf}(c1,\text{independentContinuant},t) \\ &\quad \leftrightarrow \exists t \text{instanceOf}(c1,\text{continuant},t) \\ &\quad \wedge \neg (\exists c2,t (\text{specificallyDependsOn}(c1,c2,t) \vee \text{genericallyDependsOn}(c1,c2,t)))) \end{aligned}$$

An object aggregate has more than one member at at least one time [ibd-1]

$$\begin{aligned} &\forall ag (\exists t \text{instanceOf}(ag,\text{objectAggregate},t) \\ &\quad \rightarrow \exists o1,o2,t (o1 \neq o2 \wedge \text{instanceOf}(o1,\text{object},t) \wedge \text{memberPartOf}(o1,ag,t) \\ &\quad \wedge \text{instanceOf}(o2,\text{object},t) \wedge \text{memberPartOf}(o2,ag,t))) \end{aligned}$$

All parts of an aggregate overlap some member [fsy-1]

$$\begin{aligned} &\forall t,b,x (\text{properContinuantPartOf}(x,b,t) \wedge \text{instanceOf}(b,\text{objectAggregate},t) \\ &\quad \rightarrow \exists o (\text{memberPartOf}(o,b,t) \\ &\quad \wedge (\exists z (\text{continuantPartOf}(z,x,t) \wedge \text{continuantPartOf}(z,o,t)))))) \end{aligned}$$

If a material entity has a proper part, then at least one of its proper parts is not an immaterial entity [adm-1]

$$\begin{aligned} &\forall m,t (\text{instanceOf}(m,\text{materialEntity},t) \wedge (\exists mp (\text{continuantPartOf}(mp,m,t) \wedge mp \neq m)) \\ &\quad \rightarrow \exists mp (mp \neq m \wedge \text{continuantPartOf}(mp,m,t) \wedge \neg \text{instanceOf}(mp,\text{immaterialEntity},t))) \end{aligned}$$

An object aggregate has member parts only disjoint objects [evk-1]

$$\begin{aligned} &\forall b,c,t (\text{memberPartOf}(b,c,t) \\ &\quad \leftrightarrow \text{instanceOf}(b,\text{object},t) \wedge \text{instanceOf}(c,\text{objectAggregate},t) \\ &\quad \wedge \text{properContinuantPartOf}(b,c,t) \\ &\quad \wedge (\forall d (\text{memberPartOf}(d,c,t) \\ &\quad \rightarrow b=d \vee \neg (\exists z (\text{continuantPartOf}(z,b,t) \wedge \text{continuantPartOf}(z,d,t))))) \end{aligned}$$

