BFO 2020 Universal Declaration Axioms

(1) Process is subclass of occurrent

$\forall t,x\,(instanceOf(x,process,t) \rightarrow instanceOf(x,occurrent,t))$

(2) If something is a continuant fiat boundary at any time then as long as it exists it is a continuant fiat boundary.

$\forall x\,(\exists t\,instanceOf(x,continuantFiatBoundary,t)$
$\rightarrow \forall t\,(existsAt(x,t) \rightarrow instanceOf(x,continuantFiatBoundary,t)))$

(3) Two dimensional spatial region is a universal

$universal(twoDimensionalSpatialRegion)$

(4) If something is a independent continuant at any time then as long as it exists it is a independent continuant.

$\forall x\,(\exists t\,instanceOf(x,independentContinuant,t)$
$\rightarrow \forall t\,(existsAt(x,t) \rightarrow instanceOf(x,independentContinuant,t)))$

(5) Realizable entity is a universal

$universal(realizableEntity)$

(6) Temporal region is subclass of occurrent

$\forall t,x\,(instanceOf(x,temporalRegion,t) \rightarrow instanceOf(x,occurrent,t))$

(7) Quality, realizable entity are mutually disjoint

$\neg(\exists x,t\,(instanceOf(x,quality,t) \wedge instanceOf(x,realizableEntity,t)))$

(8) Spatial region is subclass of immaterial entity

$\forall t,x\,(instanceOf(x,spatialRegion,t) \rightarrow instanceOf(x,immaterialEntity,t))$

(9) If something is a zero dimensional spatial region at any time then as long as it exists it is a zero dimensional spatial region.

$\forall x\,(\exists t\,instanceOf(x,zeroDimensionalSpatialRegion,t)$
$\rightarrow \forall t\,(existsAt(x,t) \rightarrow instanceOf(x,zeroDimensionalSpatialRegion,t)))$

(10) Zero dimensional temporal region is a universal

$universal(zeroDimensionalTemporalRegion)$

(11) Zero dimensional spatial region is subclass of spatial region

$\forall t,x\,(instanceOf(x,zeroDimensionalSpatialRegion,t) \rightarrow instanceOf(x,spatialRegion,t))$

(12) Specifically dependent continuant, independent continuant, generically dependent continuant are mutually disjoint

$\neg(\exists x,t\,(instanceOf(x,specificallyDependentContinuant,t)$
$\wedge instanceOf(x,independentContinuant,t)))$
$\wedge \neg(\exists x,t\,(instanceOf(x,specificallyDependentContinuant,t)$
$\wedge instanceOf(x,genericallyDependentContinuant,t)))$
$\wedge \neg(\exists x,t\,(instanceOf(x,independentContinuant,t)$
$\wedge instanceOf(x,genericallyDependentContinuant,t)))$

(13) Zero dimensional spatial region is a universal

$universal(zeroDimensionalSpatialRegion)$

(14) Temporal interval is a universal

$universal(temporalInterval)$

(15) If something is a quality at any time then as long as it exists it is a quality.

$\forall x\,(\exists t\,instanceOf(x,quality,t) \rightarrow \forall t\,(existsAt(x,t) \rightarrow instanceOf(x,quality,t)))$

(16) Spatiotemporal region is a universal

universal(spatiotemporalRegion)

(17) Generically dependent continuant is a universal

universal(genericallyDependentContinuant)

(18) Specifically dependent continuant is a universal

universal(specificallyDependentContinuant)

(19) Fiat object part is a universal

universal(fiatObjectPart)

(20) Material entity, immaterial entity are mutually disjoint

$\neg(\exists x,t(instanceOf(x,materialEntity,t) \wedge instanceOf(x,immaterialEntity,t)))$

(21) Three dimensional spatial region is subclass of spatial region

$\forall t,x(instanceOf(x,threeDimensionalSpatialRegion,t) \rightarrow instanceOf(x,spatialRegion,t))$

(22) Specifically dependent continuant is subclass of continuant

$\forall t,x(instanceOf(x,specificallyDependentContinuant,t) \rightarrow instanceOf(x,continuant,t))$

(23) One dimensional spatial region is subclass of spatial region

$\forall t,x(instanceOf(x,oneDimensionalSpatialRegion,t) \rightarrow instanceOf(x,spatialRegion,t))$

(24) Fiat point is a universal

universal(fiatPoint)

(25) Material entity is a universal

universal(materialEntity)

(26) Continuant, occurrent are mutually disjoint

$\neg(\exists x,t(instanceOf(x,continuant,t) \wedge instanceOf(x,occurrent,t)))$

(27) If something is a fiat surface at any time then as long as it exists it is a fiat surface.

$\forall x(\exists t\, instanceOf(x,fiatSurface,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,fiatSurface,t)))$

(28) Temporal instant is a universal

universal(temporalInstant)

(29) If something is a fiat point at any time then as long as it exists it is a fiat point.

$\forall x(\exists t\, instanceOf(x,fiatPoint,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,fiatPoint,t)))$

(30) No occurrent changes type during its existence

$\forall o\, (\exists t\, instanceOf(o,occurrent,t)$
$\rightarrow \forall u(\exists t\, instanceOf(o,u,t) \rightarrow \forall t(instanceOf(o,occurrent,t) \leftrightarrow instanceOf(o,u,t))))$

(31) One dimensional temporal region, zero dimensional temporal region are mutually disjoint

$\neg(\exists x,t(instanceOf(x,oneDimensionalTemporalRegion,t)$
$\wedge instanceOf(x,zeroDimensionalTemporalRegion,t)))$

(32) Fiat surface is a universal

universal(fiatSurface)

(33) Occurrent is a universal

universal(occurrent)

(34) Generically dependent continuant is subclass of continuant

$\forall t,x\,(instanceOf(x,genericallyDependentContinuant,t) \rightarrow instanceOf(x,continuant,t))$

(35) Spatial region is a universal

universal(spatialRegion)

(36) Entity is either universal or particular, so not all are instantiated. Instead make a predicate 'entity' analogous to particular universal

$\forall x\,(\exists t(instanceOf(x,continuant,t) \vee instanceOf(x,occurrent,t)) \rightarrow entity(x))$

(37) Independent continuant is a universal

universal(independentContinuant)

(38) Independent continuant is subclass of continuant

$\forall t,x\,(instanceOf(x,independentContinuant,t) \rightarrow instanceOf(x,continuant,t))$

(39) Continuant fiat boundary is subclass of immaterial entity

$\forall t,x\,(instanceOf(x,continuantFiatBoundary,t) \rightarrow instanceOf(x,immaterialEntity,t))$

(40) One dimensional temporal region is subclass of temporal region

$\forall t,x\,(instanceOf(x,oneDimensionalTemporalRegion,t) \rightarrow instanceOf(x,temporalRegion,t))$

(41) Role is subclass of realizable entity

$\forall t,x\,(instanceOf(x,role,t) \rightarrow instanceOf(x,realizableEntity,t))$

(42) Fiat object part is subclass of material entity

$\forall t,x\,(instanceOf(x,fiatObjectPart,t) \rightarrow instanceOf(x,materialEntity,t))$

(43) If something is a continuant at any time then as long as it exists it is a continuant.

$\forall x\,(\exists t\,instanceOf(x,continuant,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,continuant,t)))$

(44) History is a universal

universal(history)

(45) Universals and particulars comprise the whole domain of discourse

$\forall x\,(universal(x) \vee particular(x))$

(46) Relational quality is subclass of quality

$\forall t,x\,(instanceOf(x,relationalQuality,t) \rightarrow instanceOf(x,quality,t))$

(47) If something is a role at any time then as long as it exists it is a role.

$\forall x\,(\exists t\,instanceOf(x,role,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,role,t)))$

(48) Fiat line is subclass of continuant fiat boundary

$\forall t,x\,(instanceOf(x,fiatLine,t) \rightarrow instanceOf(x,continuantFiatBoundary,t))$

(49) Fiat surface, fiat line, fiat point are mutually disjoint

$\neg(\exists x,t(instanceOf(x,fiatSurface,t) \wedge instanceOf(x,fiatLine,t)))$
$\wedge \neg(\exists x,t(instanceOf(x,fiatSurface,t) \wedge instanceOf(x,fiatPoint,t)))$
$\wedge \neg(\exists x,t(instanceOf(x,fiatLine,t) \wedge instanceOf(x,fiatPoint,t)))$

(50) Disposition, role are mutually disjoint

$\neg(\exists x,t(instanceOf(x,disposition,t) \wedge instanceOf(x,role,t)))$

(51) Process boundary is subclass of occurrent

$\forall t,x(instanceOf(x,processBoundary,t) \rightarrow instanceOf(x,occurrent,t))$

(52) Realizable entity is subclass of specifically dependent continuant

$\forall t,x(instanceOf(x,realizableEntity,t) \rightarrow instanceOf(x,specificallyDependentContinuant,t))$

(53) If something is a one dimensional spatial region at any time then as long as it exists it is a one dimensional spatial region.

$\forall x(\exists t\, instanceOf(x,oneDimensionalSpatialRegion,t)$
$\rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,oneDimensionalSpatialRegion,t)))$

(54) Temporal region is a universal

$universal(temporalRegion)$

(55) If something is a material entity at any time then as long as it exists it is a material entity.

$\forall x(\exists t\, instanceOf(x,materialEntity,t)$
$\rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,materialEntity,t)))$

(56) Two dimensional spatial region is subclass of spatial region

$\forall t,x(instanceOf(x,twoDimensionalSpatialRegion,t) \rightarrow instanceOf(x,spatialRegion,t))$

(57) Function is subclass of disposition

$\forall t,x(instanceOf(x,function,t) \rightarrow instanceOf(x,disposition,t))$

(58) Universals are not particulars

$\neg(\exists x(universal(x) \wedge particular(x)))$

(59) If something is a spatial region at any time then as long as it exists it is a spatial region.

$\forall x(\exists t\, instanceOf(x,spatialRegion,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,spatialRegion,t)))$

(60) Fiat point is subclass of continuant fiat boundary

$\forall t,x(instanceOf(x,fiatPoint,t) \rightarrow instanceOf(x,continuantFiatBoundary,t))$

(61) Disposition is a universal

$universal(disposition)$

(62) Relational quality is a universal

$universal(relationalQuality)$

(63) Fiat line is a universal

$universal(fiatLine)$

(64) Object is subclass of material entity

$\forall t,x(instanceOf(x,object,t) \rightarrow instanceOf(x,materialEntity,t))$

(65) Fiat surface is subclass of continuant fiat boundary

$\forall t,x(instanceOf(x,fiatSurface,t) \rightarrow instanceOf(x,continuantFiatBoundary,t))$

(66) If something is a fiat line at any time then as long as it exists it is a fiat line.

$\forall x(\exists t\, instanceOf(x,fiatLine,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,fiatLine,t)))$

(67) If something is a three dimensional spatial region at any time then as long as it exists it is a three dimensional spatial region.

$\forall x\,(\exists t\,instanceOf(x,threeDimensionalSpatialRegion,t)$
$\qquad\rightarrow\forall t(existsAt(x,t)\rightarrow instanceOf(x,threeDimensionalSpatialRegion,t)))$

(68) Continuant, material entity, object, fiat object part, object aggregate, site, immaterial entity, continuant fiat boundary, fiat surface, fiat line, fiat point, spatial region, three dimensional spatial region, two dimensional spatial region, one dimensional spatial region, zero dimensional spatial region, independent continuant, generically dependent continuant, specifically dependent continuant, quality, relational quality, function, disposition, realizable entity, role, occurrent, process, process boundary, temporal region, zero dimensional temporal region, temporal instant, one dimensional temporal region, temporal interval, history, spatiotemporal region are all different

The axiom is too large to show. It is a conjunction of 1190 pairwise inequalities between the constants continuant, materialEntity, object, fiatObjectPart, objectAggregate, site, immaterialEntity, continuantFiatBoundary, fiatSurface, fiatLine, fiatPoint, spatialRegion, threeDimensionalSpatialRegion, twoDimensionalSpatialRegion, oneDimensionalSpatialRegion, zeroDimensionalSpatialRegion, independentContinuant, genericallyDependentContinuant, specificallyDependentContinuant, quality, relationalQuality, function, disposition, realizableEntity, role, occurrent, process, processBoundary, temporalRegion, zeroDimensionalTemporalRegion, temporalInstant, oneDimensionalTemporalRegion, temporalInterval, history and spatiotemporalRegion.

(69) If something is an instance of temporal region at t, then t is part of that temporal region

$\forall ti,t(instanceOf(ti,temporalRegion,t)\rightarrow temporalPartOf(t,ti))$

(70) Temporal instant is subclass of zero dimensional temporal region

$\forall t,x\,(instanceOf(x,temporalInstant,t)\rightarrow instanceOf(x,zeroDimensionalTemporalRegion,t))$

(71) If something is a two dimensional spatial region at any time then as long as it exists it is a two dimensional spatial region.

$\forall x\,(\exists t\,instanceOf(x,twoDimensionalSpatialRegion,t)$
$\qquad\rightarrow\forall t(existsAt(x,t)\rightarrow instanceOf(x,twoDimensionalSpatialRegion,t)))$

(72) Immaterial entity is subclass of independent continuant

$\forall t,x\,(instanceOf(x,immaterialEntity,t)\rightarrow instanceOf(x,independentContinuant,t))$

(73) Zero dimensional temporal region is subclass of temporal region

$\forall t,x\,(instanceOf(x,zeroDimensionalTemporalRegion,t)\rightarrow instanceOf(x,temporalRegion,t))$

(74) If something is a immaterial entity at any time then as long as it exists it is a immaterial entity.

$\forall x\,(\exists t\,instanceOf(x,immaterialEntity,t)$
$\qquad\rightarrow\forall t(existsAt(x,t)\rightarrow instanceOf(x,immaterialEntity,t)))$

(75) If something is a site at any time then as long as it exists it is a site.

$\forall x\,(\exists t\,instanceOf(x,site,t)\rightarrow\forall t(existsAt(x,t)\rightarrow instanceOf(x,site,t)))$

(76) Site is subclass of immaterial entity

$\forall t,x\,(instanceOf(x,site,t)\rightarrow instanceOf(x,immaterialEntity,t))$

(77) Site is a universal

$universal(site)$

(78) Zero dimensional spatial region, one dimensional spatial region, two dimensional spatial region, three dimensional spatial region are mutually disjoint

$$\neg(\exists x,t(instanceOf(x,zeroDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,oneDimensionalSpatialRegion,t)))$$
$$\wedge \neg(\exists x,t(instanceOf(x,zeroDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,twoDimensionalSpatialRegion,t)))$$
$$\wedge \neg(\exists x,t(instanceOf(x,zeroDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,threeDimensionalSpatialRegion,t)))$$
$$\wedge \neg(\exists x,t(instanceOf(x,oneDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,twoDimensionalSpatialRegion,t)))$$
$$\wedge \neg(\exists x,t(instanceOf(x,oneDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,threeDimensionalSpatialRegion,t)))$$
$$\wedge \neg(\exists x,t(instanceOf(x,twoDimensionalSpatialRegion,t)$$
$$\wedge instanceOf(x,threeDimensionalSpatialRegion,t)))$$

(79) Material entity is subclass of independent continuant

$$\forall t,x(instanceOf(x,materialEntity,t) \rightarrow instanceOf(x,independentContinuant,t))$$

(80) History is subclass of process

$$\forall t,x(instanceOf(x,history,t) \rightarrow instanceOf(x,process,t))$$

(81) One dimensional spatial region is a universal

universal(oneDimensionalSpatialRegion)

(82) Quality is a universal

universal(quality)

(83) If something is a function at any time then as long as it exists it is a function.

$$\forall x(\exists t\, instanceOf(x,function,t) \rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,function,t)))$$

(84) Continuant is a universal

universal(continuant)

(85) If something is a relational quality at any time then as long as it exists it is a relational quality.

$$\forall x(\exists t\, instanceOf(x,relationalQuality,t)$$
$$\rightarrow \forall t(existsAt(x,t) \rightarrow instanceOf(x,relationalQuality,t)))$$

(86) One dimensional temporal region is a universal

universal(oneDimensionalTemporalRegion)

(87) Process boundary is a universal

universal(processBoundary)

(88) Function is a universal

universal(function)

(89) Role is a universal

universal(role)

(90) Immaterial entity is a universal

universal(immaterialEntity)

(91) Three dimensional spatial region is a universal

universal(threeDimensionalSpatialRegion)

(92) Quality is subclass of specifically dependent continuant

$$\forall t,x(instanceOf(x,quality,t) \rightarrow instanceOf(x,specificallyDependentContinuant,t))$$

(93) Temporal interval is subclass of one dimensional temporal region

$\forall t,x\,(\text{instanceOf}(x,\text{temporalInterval},t) \rightarrow \text{instanceOf}(x,\text{oneDimensionalTemporalRegion},t))$

(94) Object aggregate is a universal

$\text{universal}(\text{objectAggregate})$

(95) If something is a disposition at any time then as long as it exists it is a disposition.

$\forall x\,(\exists t\,\text{instanceOf}(x,\text{disposition},t) \rightarrow \forall t\,(\text{existsAt}(x,t) \rightarrow \text{instanceOf}(x,\text{disposition},t)))$

(96) Object aggregate is subclass of material entity

$\forall t,x\,(\text{instanceOf}(x,\text{objectAggregate},t) \rightarrow \text{instanceOf}(x,\text{materialEntity},t))$

(97) If something is a realizable entity at any time then as long as it exists it is a realizable entity.

$\forall x\,(\exists t\,\text{instanceOf}(x,\text{realizableEntity},t)$
$\rightarrow \forall t\,(\text{existsAt}(x,t) \rightarrow \text{instanceOf}(x,\text{realizableEntity},t)))$

(98) Object is a universal

$\text{universal}(\text{object})$

(99) Continuant fiat boundary is a universal

$\text{universal}(\text{continuantFiatBoundary})$

(100) Process is a universal

$\text{universal}(\text{process})$

(101) If something is a generically dependent continuant at any time then as long as it exists it is a generically dependent continuant.

$\forall x\,(\exists t\,\text{instanceOf}(x,\text{genericallyDependentContinuant},t)$
$\rightarrow \forall t\,(\text{existsAt}(x,t) \rightarrow \text{instanceOf}(x,\text{genericallyDependentContinuant},t)))$

(102) If something is a specifically dependent continuant at any time then as long as it exists it is a specifically dependent continuant.

$\forall x\,(\exists t\,\text{instanceOf}(x,\text{specificallyDependentContinuant},t)$
$\rightarrow \forall t\,(\text{existsAt}(x,t) \rightarrow \text{instanceOf}(x,\text{specificallyDependentContinuant},t)))$

(103) Process, spatiotemporal region, process boundary, temporal region are mutually disjoint

$\neg(\exists x,t\,(\text{instanceOf}(x,\text{process},t) \wedge \text{instanceOf}(x,\text{spatiotemporalRegion},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{process},t) \wedge \text{instanceOf}(x,\text{processBoundary},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{process},t) \wedge \text{instanceOf}(x,\text{temporalRegion},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{spatiotemporalRegion},t) \wedge \text{instanceOf}(x,\text{processBoundary},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{spatiotemporalRegion},t) \wedge \text{instanceOf}(x,\text{temporalRegion},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{processBoundary},t) \wedge \text{instanceOf}(x,\text{temporalRegion},t)))$

(104) Spatiotemporal region is subclass of occurrent

$\forall t,x\,(\text{instanceOf}(x,\text{spatiotemporalRegion},t) \rightarrow \text{instanceOf}(x,\text{occurrent},t))$

(105) Site, spatial region, continuant fiat boundary are mutually disjoint

$\neg(\exists x,t\,(\text{instanceOf}(x,\text{site},t) \wedge \text{instanceOf}(x,\text{spatialRegion},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{site},t) \wedge \text{instanceOf}(x,\text{continuantFiatBoundary},t)))$
$\wedge \neg(\exists x,t\,(\text{instanceOf}(x,\text{spatialRegion},t) \wedge \text{instanceOf}(x,\text{continuantFiatBoundary},t)))$

(106) Disposition is subclass of realizable entity

$\forall t,x\,(\text{instanceOf}(x,\text{disposition},t) \rightarrow \text{instanceOf}(x,\text{realizableEntity},t))$

Alan Ruttenberg, December 5, 2019