Making BFO categories explicit for increased user-friendliness

Selja Seppälä

BFO meeting

May 13-14, 2013

Buffalo, NY

Background

- Research in terminology and NLP
  - develop definition authoring tools
  - create language- and domain-independent definition templates
  - use BFO categories
- Difficulties for non experts
  - scattered information in specifications
  - logical definitions
  - OWL file and Protégé output

  ➔ hard to understand

Objectives

- Analysis of BFO categories as relational configurations: 'ENTITY+relation+RELATUM'
- Benefits
  - helping (inexperienced) BFO users to understand the categories and their relations to each other
  - increasing user-friendliness of the manual
  - controlling quality of the specifications,
    e.g. spotting terminological inconsistencies, ambiguities
- Further uses
  - definition writing
  - ontology versioning

Example of relational model: OBJECT

INDEPENDENT CONTINUANT

is_a SNAP CONTINUANT

bearer_of QUALITY

bearer_of REALIZABLE ENTITY

located_at TEMPORAL REGION

located_in SITE

participates_in PROCESSUAL ENTITY

OBJECT

is_a INDEPENDENT CONTINUANT

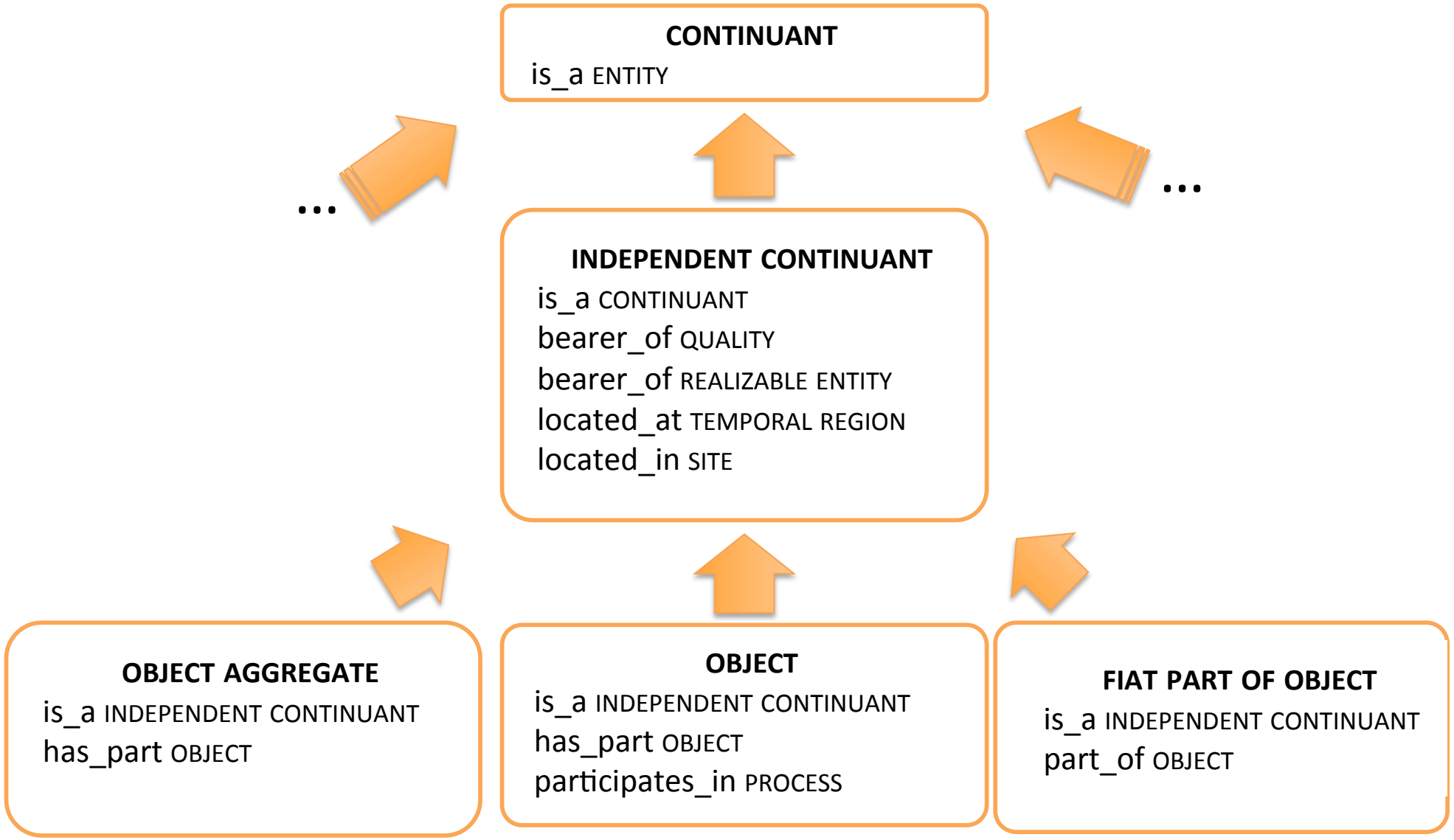
has_part OBJECT

participates_in PROCESS

Relations inherited from the entity type INDEPENDENT CONTINUANT

Relations characterizing the entity type OBJECT

Output example: BFO 1.0



Example of XML encodings for OBJECT and FIAT OBJECT PART

```
l-stylesheet type="text/xsl" href="./affichageModelesBFO.xsl"?>
ELES_RELATIONNELS>
<MODELE idModele="1" entiteModele="entity">…</MODELE>
<MODELE idModele="2" entiteModele="continuant">…</MODELE>
<MODELE idModele="3" entiteModele="independent continuant">…</MODELE>
<MODELE idModele="4" entiteModele="material entity">…</MODELE>
<MODELE idModele="5" entiteModele="object aggregate">…</MODELE>
<MODELE idModele="6" entiteModele="object">
    <ENTITE idEntite="6" onto="BFO2" source="BFO2_20120724">object</ENTITE>
    <TRAIT idTrait="6.1" nameTrait="is_a material entity">…</TRAIT>
    <TRAIT idTrait="6.2" nameTrait="occupies spatial region">
        <RELATION onto="BFO2" source="BFO2_20120724" temp="at_t" fullName="occupies_spatial_region">occupies</RELATIO
        <RELATUM onto="BFO2" source="BFO2_20120724">spatial region</RELATUM>
        <TEMPORALITY onto="BFO2" source="BFO2_20120724">at_t</TEMPORALITY>
        <EXPRESSION>occupies SPATIAL REGION</EXPRESSION>
        <COMMENT source="BFO2_20120724_p23">every object requires, at any given time t, some spatial region at which
    </TRAIT>
    <TRAIT idTrait="6.3" nameTrait="has_part object" mod="some">…</TRAIT>
    <TRAIT idTrait="6.4" nameTrait="has_part object aggregate" mod="some">…</TRAIT>
    <TRAIT idTrait="6.5" nameTrait="has_part immaterial entity" mod="some">…</TRAIT>
    <COMMENT source="BFO2_20120724_p4">1.2.1    Clarification of BFO:object…</COMMENT>
    <COMMENT source="BFO2_20120724_p29-30">we define three children of 'material entity' – namely 'object', 'object ag
    <COMMENT source="BFO2_20120724_p30-31">Examples of units of special importance for the purposes of natural science
    <COMMENT source="BFO2_20120724_p31-34">[...]conditions to be used when deciding whether entities of a given type
    <COMMENT source="BFO2_20120724_p31">We consider three candidate groups of examples of objects in the BFO sense, na
    <COMMENT source="BFO2_20120724_p35">Objects can be joined to other objects [...] entities lying at or near the bou
    <COMMENT source="BFO2_20120724_p35">Some instances of any given BFO:object universal – for example cell or organis
</MODELE>
<MODELE idModele="7" entiteModele="fiat object part">
    <ENTITE idEntite="7" onto="BFO2" source="OWL">fiat object</ENTITE>
    <SYNONYM idEntite="7" onto="BFO2" source="BFO">fiat object part</SYNONYM>
    <TRAIT idTrait="7.1" nameTrait="is_a material entity">…</TRAIT>
    <TRAIT idTrait="7.2" nameTrait="proper_continuant_part_of object">…</TRAIT>
    <COMMENT source="BFO2_20120724_p39">ELUCIDATION: b is a fiat object part = Def. b is a material entity which is su
    <COMMENT source="BFO2_20120724_p39">EXAMPLES: the upper and lower lobes of the left lung, the dorsal and ventral
    <COMMENT source="BFO2_20120724_p39">Since fiat object parts are material entities, they are also extended in space
    <COMMENT source="BFO2_20120724_p39">Fiat object parts are contrasted with bona fide object parts, which are themse
    <COMMENT source="FOL_p3">FiatObjectPart(a) =df (MaterialEntity(a)∧¬Object(a)∧∃(b,t)(Object(b)∧properContinuantPart
</MODELE>
ML    Tab Size: 4
```

Relational configurations

Fraction of the RCs in BFO 2.0 specifications

ENTITY TYPE	RELATION	RELATUM
ENTITY [no]	s-depends_on (does_not_s-depend_on)	ITS CONTINUANT OR OCCURRENT PARTS???
ENTITY [no]	s-depends_on (does_not_s-depend_on)	ANYTHING IT IS PART OF???
ENTITY	s-depends_on [during_t]	INDEPENDENT CONTINUANT
CONTINUANT	is_a	ENTITY
CONTINUANT	part_of (continuant_part_of) [at_t]	CONTINUANT
CONTINUANT	part_of (proper_continuant_part_of) [at_t]	CONTINUANT [distinct???]
CONTINUANT	has_part (has_continuant_part) [at_t]	CONTINUANT
CONTINUANT	has_part (has_proper_continuant_part) [at_t]	CONTINUANT
CONTINUANT	part_of (continuant_part_of) [at_all_times_that_part_exists]	CONTINUANT
CONTINUANT	has_part (has_continuant_part) [at_all_times_that_part_exists]	CONTINUANT
CONTINUANT	part_of (member_part_of) [at_t]	CONTINUANT
CONTINUANT	has_part (has_member_part) [at_all_times_that_whole_exists]	CONTINUANT
CONTINUANT	part_of (member_part_of) [at_t]	CONTINUANT
CONTINUANT	has_part (has_member_part) [at_t]	CONTINUANT
CONTINUANT [some??? except spatial region]	participates_in	OCCURRENT
CONTINUANT	part_of (continuant_part_of) [at_t]	CONTINUANT
INDEPENDENT CONTINUANT	is_a	CONTINUANT
INDEPENDENT CONTINUANT	occupies (occupies_spatial_region) [at_t]	SPATIAL REGION
INDEPENDENT CONTINUANT [all except spatial region]	located_in	INDEPENDENT CONTINUANT
INDEPENDENT CONTINUANT [all]	located_in	SPATIAL REGION
INDEPENDENT CONTINUANT [some??? except spatial region]	bearer_of	SPECIFICALLY DEPENDENT CONTINUANT
INDEPENDENT CONTINUANT [some??? except spatial region]	bearer_of	SPATIAL REGION [not]
INDEPENDENT CONTINUANT [some except spatial region]	bearer_of	SPECIFICALLY DEPENDENT CONTINUANT
INDEPENDENT CONTINUANT [some]	bearer_of	QUALITY
INDEPENDENT CONTINUANT [all except spatial region]	participates_in	PROCESS
INDEPENDENT CONTINUANT [all except spatial region]	has_generic_dependent	GENERICALLY DEPENDENT CONTINUANT
INDEPENDENT CONTINUANT	has_location [at_t]	INDEPENDENT CONTINUANT
INDEPENDENT CONTINUANT [some???]	participates_in	OCCURRENT
INDEPENDENT CONTINUANT [all except spatial region]	has_specific_dependent	SPECIFICALLY DEPENDENT CONTINUANT
INDEPENDENT CONTINUANT	has_specific_dependent [at_t]	PROCESS
INDEPENDENT CONTINUANT [no]	has_specific_dependent	CONTINUANT
MATERIAL ENTITY	is_a	INDEPENDENT CONTINUANT
MATERIAL ENTITY	has_part	CONTINUANT
MATERIAL ENTITY [some]	has_part	IMMATERIAL ENTITY
MATERIAL ENTITY [some]	has_part	MATERIAL ENTITY
MATERIAL ENTITY	localized_in	SPACE
MATERIAL ENTITY	exists_at	ONE-DIMENSIONAL TEMPORAL REGION (TEMPORAL INTERVAL)
MATERIAL ENTITY [some]	participates_in	PROCESS

Example of checking the RCs in BFO 2.0

ENTITY TYPE	RELATION	RELATUM
MATERIAL ENTITY	is_a	INDEPENDENT CONTINUANT
~~MATERIAL ENTITY~~	~~has_part~~	~~CONTINUANT~~
~~MATERIAL ENTITY [some]~~	~~has_part~~	~~IMMATERIAL ENTITY~~
~~MATERIAL ENTITY [some]~~	~~has_part~~	~~MATERIAL ENTITY~~
MATERIAL ENTITY	localized_in	SPACE
MATERIAL ENTITY	exists_at	ONE-DIMENSIONAL TEMPORAL REGION (TEMPORAL INTERVA
~~MATERIAL ENTITY [some]~~	~~participates_in~~	~~PROCESS~~
MATERIAL ENTITY	located_at	SPATIAL REGION
MATERIAL ENTITY	occupies (occupies_spatial_region) [at_t]	SPATIAL REGION
~~MATERIAL ENTITY~~	~~bearer_of [at_t]~~	~~QUALITY~~
~~MATERIAL ENTITY~~	~~bearer_of [at_t]~~	~~DISPOSITION~~
MATERIAL ENTITY	contains	PROCESS
MATERIAL ENTITY	contains	PROCESS BOUNDARY
MATERIAL ENTITY	has_history	PROCESS
MATERIAL ENTITY	material_basis_of [at_all_times]	DISPOSITION
MATERIAL ENTITY	material_basis_of [at_t]	DISPOSITION
MATERIAL ENTITY	occupies (occupies_spatial_region) [at_t]	THREE-DIMENSIONAL SPATIAL REGION
~~MATERIAL ENTITY [some???]~~	~~bearer_of~~	~~SPECIFICALLY DEPENDENT CONTINUANT~~
~~MATERIAL ENTITY [some???]~~	~~bearer_of~~	~~GENERICALLY DEPENDENT CONTINUANT~~
OBJECT AGGREGATE	is_a	MATERIAL ENTITY
OBJECT AGGREGATE	has_member_part [at_all_times_at_which_entity_exists]	OBJECT [plurality]
OBJECT	is_a	MATERIAL ENTITY
~~OBJECT~~	~~occupies (occupies_spatial_region) [at_t]~~	~~SPATIAL REGION~~
~~OBJECT [some]~~	~~has_part~~	~~OBJECT~~
~~OBJECT [some]~~	~~has_part~~	~~OBJECT AGGREGATE~~
~~OBJECT [some]~~	~~has_part~~	~~IMMATERIAL ENTITY~~
OBJECT	has_connected	THREE DIMENSIONAL FIAT BOUNDARY
FIAT OBJECT [FIAT OBJECT PART]	is_a	MATERIAL ENTITY
~~FIAT OBJECT [FIAT OBJECT PART]~~	~~part_of (proper continuant_part_of)~~	~~OBJECT~~

Further applications of the relational models

- Definition writing
  - domain- and language-independent templates
  - corpus tagging to extract defining information
  - annotating existing definitions
- Ontology versioning & quality control
  (Ceusters & Smith, 2006; Seppälä, submitted to ICBO2013)
  - tracking ontological changes
  - tracking terminological changes

Increasing user-friendliness

- Complement specifications with relational models
- Provide template for writing the specifications more systematically
  - ➔ specific fields for each type of information
- Add unique IDs for entity types and relations
  - ➔ to be used in all versions of BFO
- Systematically document changes
  - ➔ add change-tracking schema in appendix

Thank you.