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Information technology — Top-level ontologies (TLO) —

Part 2: Basic Formal Ontology (BFO)

Technologies de l'information — Ontologies de haut-niveau (TLO) — Partie 2: Ontologie formelle de base (BFO)

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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Introduction

Basic Formal Ontology (BFO) is a top-level ontology (TLO) conforming to ISO/IEC 21838-1. It contains (i) definitions of its terms and relational expressions and (ii) formalizations in OWL 2 and in Common Logic (CL). BFO is a public-domain resource introduced in 2002. It is an ontology of highly general terms designed to support the interoperability of data and information systems associated with ontologies containing more specific terms relating to specific domains. The primary goal of BFO is to support the development of such domain ontologies in a way that promotes the coordination of ontology development by different groups in a way that promotes consistency and non-redundancy. BFO was initially conceived as part of a strategy to advance coordinated domain ontology development across the life sciences. BFO has since been used for similar purposes in other areas, including data and information science, sustainable development, and in the engineering, military and intelligence fields. This document was developed as a response to the need for a TLO designed to support information system interoperability expressed by ontology users in these and other areas.

BFO is a domain-neutral ontology. This means that it provides terms representing only highly general categories – such as object, quality, process, spatial and temporal region – which pertain to all domains of reality.

BFO has existed thus far in four major release versions.

Version 1.0 (released in 2002)

Version 1.1 (released in 2007)

Version 2.0 (released in 2015)[7]

Version 2020 (released in 2020)[10], [11]

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Through these successive versions the categorial core of BFO, resting on a distinction between continuants and occurrents, and between dependent and independent entities, has remained constant. Version 1.1 added the new category of generically dependent continuant, which was introduced to provide a starting point for definitions of terms representing information artefacts and other dependent entities (such as nucleic acid sequences) which can exist in multiple copies. Version 2.0 differs from its predecessors in a series of minor changes which flowed from a major re-formalization using the OWL 2 language[3].

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The BFO-2020 category hierarchy is illustrated in Figure 1. This extends the category hierarchy of BFO 2.0 through the inclusion of two terms (“temporal instant” and “temporal interval”) and through the renaming of terms relating to fiat boundaries. BFO-2020 also adds a systematic repertoire of inverse relations to the relations in BFO 2.0 and an enriched treatment of relations involving time.

BFO-2020-Terms, the natural language specification of BFO-2020, supports human maintenance and use of the ontology, including use in development of BFO-conformant domain ontologies.

BFO-2020-OWL, the OWL 2 formalization of BFO-2020, supports use of the ontology in computing, including enabling BFO-2020 to be used in tandem with other ontologies expressed in OWL and in related languages, and in allowing ontology quality control through use of OWL reasoners.

BFO-2020-CL, the CL formalization of BFO-2020, provides the expressivity needed to capture the formal structures used by BFO-2020, for example in its treatment of time, space and parthood.

This document conforms to ISO/IEC 21838-1.

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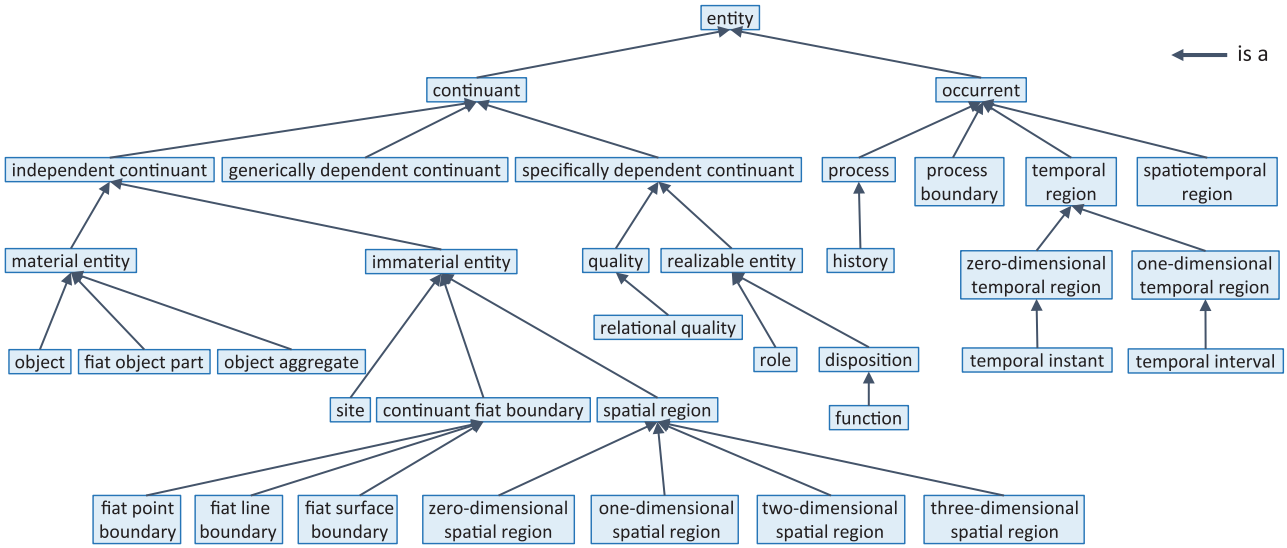

Figure 1 — BFO-2020 is_a hierarchy

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Information technology — Top-level ontologies (TLO) —

Part 2:
Basic Formal Ontology (BFO)

1 Scope

This document describes Basic Formal Ontology (BFO), which is an ontology that is conformant to the requirements specified for top-level ontologies in ISO/IEC 21838-1.

It describes BFO as a resource designed to support the interchange of information among heterogeneous information systems. The following are within the scope of this document:

— definitions of BFO-2020 terms and relations;

— axiomatizations of BFO-2020 in OWL 2 and CL;

— documentation of the conformity of BFO-2020 to the requirements specified for top-level ontologies in ISO/IEC 21838-1;

— specification of the requirements for a domain ontology if it is to serve as a module in a suite of ontologies in which BFO serves as top-level ontology hub by providing a starting point for the introduction of the most general terms in those domain ontologies which are its nearest neighbours within the suite;

— specification of the role played by the terms in BFO in the formulation of definitions and axioms in ontologies at lower levels that conform to BFO.

The following are outside the scope of this document:

— specification of ontology languages, including the languages RDF, OWL, and CL standardly used in ontology development;

— specification of methods for reasoning with ontologies;

— specification of translators between the notations of ontologies developed in different ontology languages.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 21838-1:2021, *Information technology — Top-level ontologies (TLO) — Part 1: Requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 21838-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

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— IEC Electropedia: available at http://www.electropedia.org/

NOTE The following terms and definitions, along with the definitions in ISO/IEC 21838-1, form part of the meta-vocabulary used for describing BFO-2020 in this document, except that in BFO the terms "entity" and "object" are not synonyms. The vocabulary of BFO-2020 itself is documented in https://standards.iso.org/iso-iec/21838/-2/ed-1/en.

3.1
primitive
expression for which no non-circular definition can be provided

3.2
universal
type
entity (3.1) that has indefinitely many *instances* (3.6)

EXAMPLE Electron, molecule, cell, planet, explosion, vehicle, hour, traffic law, organization, mortgage contract, email message.

Note 1 to entry: References to universals are employed in the formulation of the assertions of natural science and of analogous general assertions in technical manuals, experimental protocols or legal or administrative documents.

3.3
extension
collection (3.4) of instances of a *universal* (3.2)

Note 1 to entry: In OWL, every Class is associated with a Class Extension, which is the set of Instances of the Class. In Reference [4] (from 2004), it is asserted that: "A class has an intensional meaning (the underlying concept) which is related but not equal to its class extension. Thus, two classes may have the same class extension, but still be different classes."

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3.4
collection
group of particulars

Note 1 to entry: The particulars in a collection are called its members.

Note 2 to entry: The term "collection" is to be understood as allowing change of members over time (see ISO/IEC 21838-1:2021, B.3.2).

3.5
defined class
collection (3.4), whose members are defined by specifying a restriction on one or more *universals* (3.2), that is not the *extension* (3.3) of any *universal* (3.2)

EXAMPLE Non-smoker (meaning: person who does not smoke); pet (meaning: animal that is kept for companionship or pleasure); mortgagee (meaning: person with a mortgage); lathe operator (meaning: person with an employment role realized through operating a lathe); target (meaning: thing or process that is targeted).

Note 1 to entry: In the OWL 2 community the expression "Defined Class" is sometimes used informally to refer to those Classes in an ontology in which both necessary and sufficient conditions are provided, as contrasted with what are called "Primitive Classes" for which only necessary conditions are provided.

3.6
instance
particular that instantiates some *universal* (3.2)

EXAMPLE John, John's laptop, the year 2012.

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