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Information technology — Top-level ontologies (TLO) —

Part 1: Requirements

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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*.

A list of all parts in the ISO/IEC 21838 series can be found on the ISO website.

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.

Introduction

This document was developed in response to the demand from many quarters for ontology-based solutions to the problem of semantic interoperability across networks of information systems. The demand arises particularly from large organizations and consortia of organizations in areas such as bioinformatics, healthcare, the manufacturing industry and military and government administration, where independently created information systems need to exchange data in such a way that meaning is preserved.

An ontology is on the one hand an artefact for human use, built out of terms and relations expressed using natural language. On the other hand, it is an artefact for use by computers, which requires that these terms and relations are captured in a formal language that is machine readable and has well-defined (typically, model-theoretic) semantics. Multiple languages have been developed for the purposes of ontology formalization, of which Common Logic (CL) and the Web Ontology Language (OWL) – specifically OWL 2 with direct semantics – are normatively referenced in this document.

An ontology can help to achieve sharing of meaning because its terms are associated with formal definitions specifying their meanings in a way that can be processed computationally. If an ontology can be shared across participating organizations, then data can be exchanged in such a way that meaning is preserved if the data can be associated with corresponding shared ontology terms.

CL and OWL 2 serve different ends. CL is a logical framework with the full expressivity of first-order logic (FOL), the unifying framework for all semantic web applications. Formalization in a language with the expressivity of FOL is required for the purposes of this document since weaker expressivity would not allow the ontology to capture in a formal way the implications of axioms in areas such as mereology and theories of location and change.

Formalization in a language like OWL 2 is needed, even though it is less expressive than CL, since it is decidable and this means that it can be used effectively by computer systems for purposes of logical reasoning and ontology quality assurance.

Where heterogeneous bodies of data need to be exchanged or manipulated, some have adopted approaches that involve the creation of a suite of ontologies incorporating a distinction of levels, with a single very general ontology at the top, governing one or more specific ontology modules at lower levels (Annex A provides examples). This document addresses the need that arises for those communities that have adopted such multi-level approaches. Specifically, its purpose is to specify what is required of a top-level ontology if it is to serve the needs of those building or re-engineering ontologies or other legacy systems at lower levels in a way that will support semantic interoperability among them.

To be fit for purpose, a top-level ontology needs to have appropriate content that is well documented and be available in machine-readable forms providing support for computational reasoning. This document specifies these requirements in terms of coverage, documentation and representation.

Information technology — Top-level ontologies (TLO) —

Part 1:
Requirements

1 Scope

This document specifies required characteristics of a domain-neutral top-level ontology (TLO) that can be used in tandem with domain ontologies at lower levels to support data exchange, retrieval, discovery, integration and analysis.

If an ontology is to provide the overarching ontology content that will promote interoperability of domain ontologies and thereby support the design and use of purpose-built ontology suites, then it needs to satisfy certain requirements. This document specifies these requirements. It also supports a variety of other goals related to the achievement of semantic interoperability, for example, as concerns legacy ontologies developed using heterogeneous upper-level categories, where a coherently designed TLO can provide a target for coordinated re-engineering.

This document specifies the characteristics an ontology needs to possess to support the goals of exchange, retrieval, discovery, integration and analysis of data by computer systems.

The following are within the scope of this document

— Specification of the requirements an ontology needs to satisfy if it is to serve as a top-level hub ontology.

— Specification of the relations between a top-level ontology and domain ontologies.

— Specification of the role played by the terms in a top-level ontology in the formulation of definitions and axioms in ontologies at lower levels.

The following are outside the scope of this document:

— Specification of ontology languages, including the languages OWL 2 and CL, used in ontology development with standard model-theoretic semantics.

— Specification of methods for reasoning with ontologies.

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

— Specification of rules governing the use of IRIs as permanent identifiers for ontology terms.

— Specification of the principles of ontology maintenance and versioning.

— Specification of how ontologies can be used in the tagging or annotation of data.

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 24707, *Information technology — Common Logic (CL) — A framework for a family of logic-based languages*

WORLD WIDE WEB CONSORTIUM *W3C Recommendation — OWL 2 Web Ontology Language Document Overview* (Second Edition), https://www.w3.org/TR/2012/REC-owl2-overview-20121211/

WORLD WIDE WEB CONSORTIUM *W3C Recommendation — OWL 2 Web Ontology Language Direct Semantics*, https://www.w3.org/TR/owl2-direct-semantics/

WORLD WIDE WEB CONSORTIUM *W3C Recommendation — OWL 2 Web Ontology Language Structural Specification and Functional-Style Syntax* (Second Edition), http://www.w3.org/TR/2012/REC-owl2-syntax-20121211/

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

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

NOTE The following terms and definitions are not intended as a substitute for existing technical vocabularies used in ontology development and maintenance, for example, as defined by the W3C. To reduce the possibility of confusion, expressions used in describing a W3C recommended usage are capitalized.

3.1
entity
object
item that is perceivable or conceivable

Note 1 to entry: The terms 'entity' and 'object' are catch-all terms analogous to 'something'. In terminology circles 'object' is commonly used in this way. In ontology circles, 'entity' and 'thing' are commonly used. See B.3.3.

[SOURCE: ISO 1087-1:2000]

3.2
class
general *entity* (3.1)

Note 1 to entry: In some ontology communities, all general entities are referred to as classes. In other ontology communities, a distinction is drawn between classes as the extensions of general entities (for example, as sets of instances) and the general entities themselves, sometimes referred to as 'types', 'kinds', or 'universals'. The expression 'class or type' is used in this document in order to remain neutral regarding these different usages.

3.3
particular
individual *entity* (3.1)

Note 1 to entry: In contrast to classes or types, particulars are not exemplified or instantiated by further entities.

3.4
relation
way in which *entities* (3.1) are related

Note 1 to entry: Relations can hold between particulars (this leg *is part of* this lion); or between classes or types (mammal *is a subclass of* organism); or between particulars and classes or types (this lion *is an instance of* mammal). On some views, identity is treated as a relation connecting one entity to itself.

Note 2 to entry: On the difference between 'relation' and 'relational expression' see 3.6, Note 1 to entry.

Note 3 to entry: 'Relation' is a primitive term. See 4.1.1, NOTE 1.

