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Geographic information — Ontology —

Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)

Information géographique — Ontologie —

Partie 2: Règles pour le développement d'ontologies dans le langage d'ontologie Web (OWL)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The Committee responsible for this document is ISO/TC 211, *Geographic information/Geomatics*.

ISO 19150 consists of the following parts, under the general title *Geographic information — Ontology*:

— *Part 1: Framework*

— *Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)*

Semantic operators, *Service ontology*, *Domain ontology registry* and *Service ontology registry* are planned to be covered in future Parts.

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Introduction

Fundamentally, ontology comes from philosophy and refers to the study of the nature of the world itself. The information technology and artificial intelligence communities borrowed this term of ontology for the explicit specification of a conceptualization.[2] Information technology and artificial intelligence consider that reality may be abstracted differently depending on the context from which "things" are perceived and, as such, recognize that multiple ontologies about the same part of reality may exist. In geographic information, ontology refers to a formal representation of phenomena of a universe of discourse with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships.[1] An ontology can be formalized differently ranging from weak to strong semantics: taxonomy, thesaurus, conceptual model, logical theory.[2]

Ontology is a fundamental notion for semantic interoperability on the Semantic Web since it defines the meaning of data and describes it in a format that machines and applications can read. As such, an application using data also has access to their inherent semantics through the ontology associated with it. Therefore, ontologies can support integration of heterogeneous data captured by different communities by relating them based on their semantic similarity. The W3C has proposed the Web Ontology Language (OWL) family of knowledge representation languages for authoring ontologies characterised by formal semantics on the Web.[4,11]

Semantics is an important topic in the field of geographic information. The meaning of geographic information is essential for their discovery, sharing, integration, and use. Geographic information standards have recognized this fact in the standards on rules for application schema (ISO 19109) and the methodology for feature cataloguing (ISO 19110),[7] which are both based on the General Feature Model (GFM). Basically, semantics relates phenomena and signs used to represent them (i.e. data) by the way of concepts. Typically, concepts are maintained in repositories called ontologies.

The ISO geographic information standards have chosen the conceptual modelling language UML[10,12] for the formal representation of abstraction of the reality. Additionally as introduced in ISO/TS 19150-1:2012, there is a need to provide formal representation of abstraction of the reality in OWL to support the Semantic Web. Accordingly, this part of ISO 19150 defines rules to convert UML static views of geographic information and application schemas into OWL ontologies in order to benefit and support interoperability of geographic information over the Semantic Web. These rules are required for:

— ontology description completeness;

— consistency in the set of OWL ontologies for geographic information;

— consistency in conversion of UML diagrams to OWL ontologies; and

— cohesion and unity between UML models and ontologies.

These rules are based on but also extend the OMG's Ontology Definition Metamodel.[11] OWL ontologies are complementary to UML static views and serve different purposes.

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Geographic information — Ontology —

Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)

1 Scope

This part of ISO 19150 defines rules and guidelines for the development of ontologies to support better the interoperability of geographic information over the Semantic Web. The Web Ontology Language (OWL) is the language adopted for ontologies.

This part of ISO 19150 defines the conversion of the UML static view modeling elements used in the ISO geographic information standards into OWL. It further defines conversion rules for describing application schemas based on the General Feature Model defined in ISO 19109 into OWL.

This part of ISO 19150 does not define semantics operators, rules for service ontologies, and does not develop any ontology.

2 Conformance

Any application ontology or profile claiming conformance with this part of ISO 19150 shall pass the requirements described in the abstract test suite, presented in Annex A.

The abstract test suite is organized in two conformance classes that address the following purposes:

— Conversion of a UML package from the ISO/TC 211 Harmonized Model to OWL (conformance class 19150-2owl-conf); and

— Formalization of an application schema in OWL (conformance class 19150-2app-conf).

3 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19103:—[1)], *Geographic information — Conceptual schema language*

ISO 19107:2003, *Geographic information — Spatial schema*

ISO 19108:2002, *Geographic information — Temporal schema*

ISO 19109:—[2)], *Geographic information — Rules for application schema*

ISO 19112:2003, *Geographic information — Spatial referencing by geographic identifiers*

ISO 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 19123:2005, *Geographic information — Schema for coverage geometry and functions*

1) To be published. (Revision of ISO/TS 19103:2005)

2) To be published. (Revision of ISO 19109:2005)

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ISO 19156:2011, *Geographic information — Observations and measurements*

ISO 19157:2013, *Geographic information — Data quality*

W3C OWL 2, *OWL 2 Web Ontology Language: Structural Specification and Functional-Style Syntax* (W3C Recommendation 27 October 2009)

W3C OWL 2 RDF, *OWL 2 Web Ontology Language RDF-Based Semantics* (W3C Recommendation 27 October 2009)

W3C SKOS, *SKOS Simple Knowledge Organization System Reference* (W3C Recommendation 18 August 2009)

IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF*

IETF RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*

4 Terms, definitions, abbreviations, and namespaces

4.1 Terms and definitions

4.1.1
aggregation
<UML> special form of *association* (4.1.6) that specifies a whole-part relationship between the aggregate (whole) and a component part

Note 1 to entry: See *composition* (4.1.12).

[SOURCE: ISO 19103:—[1)], 4.1]

4.1.2
annotation
<OWL> additional information associated to ontologies, entities, and axioms

[SOURCE: OWL]

4.1.3
annotation property
<OWL> element used to provide a textual *annotation* (4.1.2) for an *ontology* (4.1.29), axiom, or an IRI

[SOURCE: OWL]

4.1.4
application ontology
ontology (4.1.29) representing the concepts and relationships in an *application schema* (4.1.5)

4.1.5
application schema
conceptual schema (4.1.14) for *data* (4.1.16) required by one or more applications

[SOURCE: ISO 19101-1:2014, 4.1.2]

4.1.6
association
<UML> semantic relationship that can occur between typed instances

Note 1 to entry: A binary association is an association among exactly two classifiers (including the possibility of an association from a classifier to itself).

[SOURCE: OMG UML, Superstructure, version 2.4.1, 7.3.3]

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