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Information technology — Criteria for concept systems

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Foreword

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Introduction

A concept system is a “set of concepts structured in one or more related domains according to the concept relations among its concepts” according to ISO 1087:2019. A concept is defined as a unit of knowledge created by a unique combination of characteristics which are the abstraction of a property of an object or of a set of objects. Concept systems are used to support semantic interoperability and integration in domains, information classification and organization, indexing, retrieval, etc.

Concept systems are used in the description of semantics of data in the ISO/IEC 11179 series of standards. ISO/IEC 11179-1 introduces data element concept, object class, property, conceptual domain and value meaning as concepts. They can be organized through the use of relations among them into concept systems. A classification scheme is represented as a concept system in ISO/IEC TR 11179-2.

There are various types of concept systems, ranging from the simplest concept systems with simple relations among concepts to ontologies with rich formal semantics.

The construction of most controlled vocabularies is based on concept systems. On the basis of the relevant concept system, they add the relationships among terms and establish the relationships among terms and concepts on the basis of semantic characteristics. Concepts are mainly represented by terms. Therefore, the discussion of the types of concept systems is inseparable from the discussion of vocabularies.

Ontologies comprise an important kind of concept system. The goals of ontologies are to capture the knowledge of one or several subject fields and to provide a common understanding. Also, ontologies serve to determine the commonly terms in the subject field, and to provide a clear understanding of the relations among the relevant concepts based on various levels of formal patterns.

The development of artificial intelligence technology and ontology technology has expanded both the content and the application of the scope of concept systems. The issues regarding the structure, classification, description and application of concept systems are becoming more and more important.

Information technology — Criteria for concept systems

1 Scope

This document provides the criteria for effective concept systems. It provides the requirements for components, formation, representations, structural levels and management of concept systems. Concept systems are used in the description of semantics of data in ISO/IEC 11179 standards.

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 704, *Terminology work — Principles and methods*

3 Terms and definitions

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

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

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

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

3.1
object
anything perceivable or conceivable

Note 1 to entry: Objects can be material (e.g. 'engine', 'sheet of paper', 'diamond'), immaterial (e.g. 'conversion ratio', 'project plan') or imagined (e.g. 'unicorn', 'scientific hypothesis').

[SOURCE: ISO 1087:2019, 3.1.1]

3.2
property
<terminology>feature of an *object* (3.1)

EXAMPLE 1 'Being made of wood' as a property of a given 'table'.

EXAMPLE 2 'Belonging to person A' as a property of a given 'pet'.

EXAMPLE 3 'Having been formulated by Einstein' as a property of a given 'E=mc2'.

EXAMPLE 4 'Being compassionate' as a property of a given 'person'.

EXAMPLE 5 'Having a given cable' as a property of a given 'computer mouse'.

Note 1 to entry: One or more objects can have the same property.

[SOURCE: ISO 1087:2019, 3.1.3]

3.3
characteristic
abstraction of a *property* (3.2)

EXAMPLE 'Having a cable for connecting with a computer' as a characteristic of the concept 'cord mouse'.

Note 1 to entry: Characteristics are used for describing concepts.

[SOURCE: ISO 1087:2019, 3.2.1]

3.4
concept
unit of knowledge created by a unique combination of *characteristics* (3.3)

Note 1 to entry: Concepts are not necessarily bound to particular natural languages. They are, however influenced by the social or cultural background which often leads to different categorizations.

Note 2 to entry: This is the concept 'concept' as used and designated by the term "concept" in terminology work. It is a very different concept from that designated by other domains such as industrial automation or marketing.

[SOURCE: ISO 1087:2019, 3.2.7]

3.5
domain
subject field
field of special knowledge

Note 1 to entry: The borderlines and the granularity of a domain are determined from a purpose-related point of view. If a domain is subdivided, the result is again a domain.

[SOURCE: ISO 1087:2019, 3.1.4]

3.6
designation
designator
representation of a *concept* (3.4) by a sign which denotes it in a *domain* (3.22) or subject

Note 1 to entry: A designation can be linguistic or non-linguistic. It can consist of various types of characters, but also punctuation marks such as hyphens and parentheses, governed by domain-, subject-, or language-specific conventions.

Note 2 to entry: A designation can be a term including appellations, a proper name, or a symbol.

[SOURCE: ISO 1087:2019, 3.4.1]

3.7
synonymy
relation between *designations* (3.6) in a given natural language representing the same *concept* (3.4)

EXAMPLE Synonymy exists between "deuterium" and "heavy hydrogen", between "United Nations" and "UN".

Note 1 to entry: Designations in the relation of synonymy are called "synonyms".

[SOURCE: ISO 1087:2019, 3.4.23]

3.8
definition
representation of a *concept* (3.8) by an expression that describes it and differentiates it from related *concepts*

[SOURCE: ISO 1087:2019, 3.3.1]

3.9
term
designation (3.6) that represents a general *concept* (3.4) by linguistic means

EXAMPLE "laser printer", "planet", "pacemaker", "chemical compound", "3/4 time", "Influenza A virus", "oil painting".

Note 1 to entry: Terms may be partly or wholly verbal.

[SOURCE: ISO 1087:2019, 3.4.2]

3.10
vocabulary
terminological dictionary that contains *designations* (3.6) and *definitions* (3.8) from one or more *domains* (3.22) or subjects

Note 1 to entry: The vocabulary may be monolingual, bilingual or multilingual.

[SOURCE: ISO 1087:2019, 3.7.5]

3.11
controlled vocabulary
CV
vocabulary (3.10) for which the entries, i.e. *definition* (3.8) /*term* (3.9) pairs, are controlled by a Source Authority based on a rulebase and process for addition/deletion of entries

Note 1 to entry: In a controlled vocabulary, there is a one-to-one relationship of definition and term.

EXAMPLE The contents of "Clause 3 Definitions" in ISO/IEC standards are examples of controlled vocabularies with the entities being identified and referenced through their ID code, i.e., via their clause numbers.

Note 2 to entry: In a multilingual controlled vocabulary, the definition/term pairs in the languages used are deemed to be equivalent, i.e., with respect to their semantics.

Note 3 to entry: The rule base governing a controlled vocabulary may include a predefined concept system.

Note 4 to entry: Source Authority is defined in ISO/IEC 15944-2:2015, 3.109. Its definition is "Person recognized by other Persons as the authoritative source for a set of constraints"

[SOURCE: ISO/IEC 15944-5:2008, 3.34, modified — added Note 4 to entry]

3.12
semantic spectrum
range of increasingly precise *definitions* (3.8)

Note 1 to entry: Generally, the semantic spectrum includes glossaries, classification schemes, taxonomies, terminologies, subject heading schemes, thesauri, ontologies, etc. according to their semantic precision.

3.13
concept relation
relation between *concepts* (3.4)

[SOURCE: ISO/IEC 11179-3:2023, 3.2.8]

3.14
hierarchical relation
hierarchical concept relation
generic relation or partitive relation

[SOURCE: ISO 1087:2019, 3.2.12]

3.15
associative relation
associative concept relation
pragmatic relation
non-hierarchical *concept relation* (3.13)

EXAMPLE An associative relation exists between the concepts 'education' and 'teaching'.

[SOURCE: ISO 1087:2019, 3.2.23]

3.16
equivalence relationship
relationship between two *designations* (3.6) that both represent the same or similar *concept* (3.4)

3.17
concept system
system of concepts
set of *concepts* (3.4) structured in one or more related *domains* (3.22) according to the *concept relations* (3.13) among its *concepts*

[SOURCE: ISO 1087:2019, 3.2.28]

3.18
glossary
terminological dictionary that contains *designations* (3.6) from one or more *domains* (3.22) or subjects together with equivalents in one or more natural languages

Note 1 to entry: In English common language usage, glossary can refer to a monolingual list of designations and definitions in a domain or subject.

[SOURCE: ISO 1087:2019, 3.7.6]

3.19
classification scheme
descriptive information for an arrangement or division of *objects* (3.1) into groups based on criteria such as *characteristics* (3.3), which the *objects* have in common

EXAMPLE Origin, composition, structure, application, function, etc.

[SOURCE: ISO/IEC 11179-3:2023, 3.2.5]

3.20
taxonomy
type of hierarchy which deals with generalization/specialization relationships

[SOURCE: ISO/IEC 11179-32:2023, 3.20, modified — Note 1 to entry deleted]

3.21
terminology
set of *designations* (3.6) and *concepts* (3.4) belonging to one *domain* (3.22) or subject

[SOURCE: ISO 1087:2019, 3.1.11]

3.22
subject heading scheme
subject heading language
subject heading list
SHL
structured *vocabulary* (3.10) comprising *terms* (3.4) available for subject indexing, plus rules for combining them into pre-coordinated strings of *terms* where necessary

[SOURCE: ISO 25964-2:2013, 3.77]

3.23
thesaurus
controlled vocabulary (3.11) and structured *vocabulary* (3.10) in which *concepts* (3.4) are represented by *terms* (3.9), organized so that relationships between *concepts* are made explicit, and preferred *terms* are accompanied by lead-in entries for synonyms or quasi-synonyms

[SOURCE: ISO 5127:2017, 3.8.3.01]

3.24
ontology
collection of *terms* (3.9), relational expressions and associated natural-language *definitions* (3.8) together with one or more formal theories designed to capture the intended interpretations of these *definitions*

[SOURCE: ISO/IEC 21838-1:2021, 3.14, modified — Note 1 to entry deleted]

4 Abbreviations

4.1 Abbreviations relating to terminology

BT Broader Term

NT Narrower Term

RT Related Term

UF Used For

4.2 Abbreviations relating to computing

CSV Comma Separated Values

JSON Java Script Object Notation

OWL Web Ontology Language

RDF Resource Description Framework

UML Unified Modeling Language

XML eXtensible Markup Language

5 Requirements for a concept system

5.1 Overview

Concept system is defined as a set of concepts structured in one or more related domains according to the concept relations among its concepts according to ISO 1087. Concept systems can be classified as a semantic spectrum by their increasingly precise definitions. Concept systems can be developed using different approaches.

The development of information technology and artificial intelligence technology aims to shift as much complex intelligent work as possible to computer systems. As a consequence, the core issue of artificial intelligence systems involves the creation of complete knowledge systems coupled with the implementation of knowledge-based reasoning skills. Using concept systems for abstracting and organizing knowledge has many benefits. A concept system serves to model concepts and relations among them based on specialized knowledge of a subject field, helps to form new concepts and terms,

forms the basis for a uniform and standardized terminology, facilitates the implementation of automated reasoning based on certain rules and facilitate the indexing, retrieval, information organization and navigation of data resources.

5.2 Components of a concept system

5.2.1 General

This subclause provides a framework for the use of general concept systems in the information technology field. This framework describes the basic components and relations making up a general concept system, so as to assist the construction of different types of concept systems. The UML[9][10] diagram shown in Figure 1 shows the framework of a general concept system.

A concept system usually consists of (1) a list of concepts, (2) characteristics of concepts, (3) relations among concepts, and possibly (4) axioms.

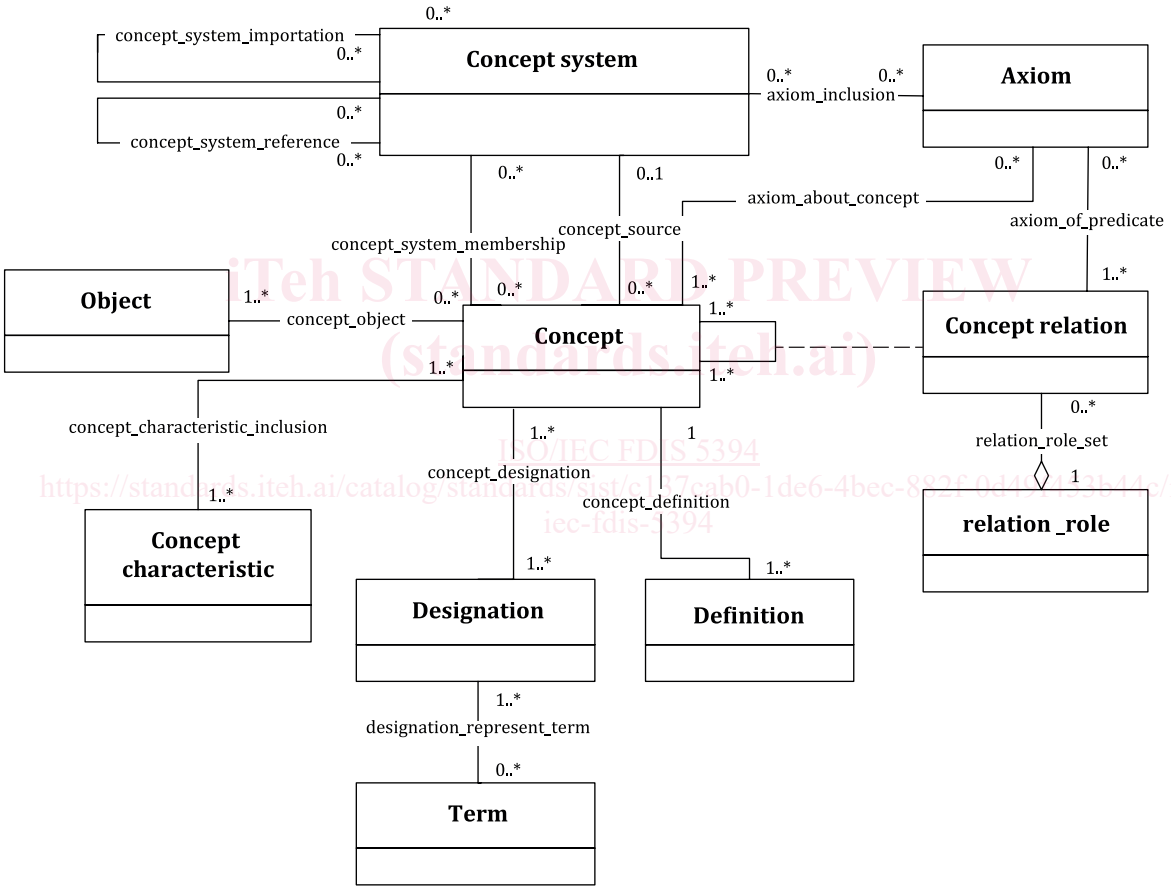

Figure 1 — Concept system framework

5.2.2 Concepts

Concepts are the core elements of any concept system. A concept is defined as a unit of knowledge created by a unique combination of characteristics which are each the abstraction of a property of an object or of a set of objects according to ISO 1087. An object is defined as anything perceived or conceived. Through observation and a process of abstraction, objects are categorized into classes, which correspond to units of knowledge called concepts.

The essential properties of the object are abstracted to form characteristics associated with the mental representation of the concept. Together, the set formed by these characteristics comprise the intension. The set of objects conceptualized as a concept is known as the extension of the concept.