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Information technology — Criteria for concept systems

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Foreword

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

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

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.

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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 **terminological 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 <http://www.electropedia.org> <https://www.electropedia.org/>

3.1 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 3.2

property

<terminology>feature of an *object* (3.1)(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/IEC 1087:2019, 3.1.3]

3.3 3.3

characteristic

abstraction of a *property* (3.2)(3.2)

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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 3.4

concept

unit of knowledge created by a unique combination of *characteristics* (3.3)(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 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 3.6

designation

designator

representation of a *concept* (3.4)(3.4) by a sign which denotes it in a *domain* (3.22)(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 3.7

synonymy

relation between *designations* (3.6)(3.6) in a given natural language representing the same *concept* (3.4)(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 3.8

definition

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

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[SOURCE: ISO 1087:2019, 3.3.1]

3.9 3.9

term

designation (3.6)(3.6) that represents a general *concept* (3.4)(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 3.10

vocabulary

terminological dictionary that contains *designations* (3.6)(3.6) and *definitions* (3.8)(3.8) from one or more *domains* (3.22)(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 3.11

controlled vocabulary

CV

vocabulary (3.10)(3.10) for which the entries, i.e. *definition* (3.8)(3.8) / *term* (3.9)(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 3.12

semantic spectrum

range of increasingly precise *definitions* (3.8)(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 3.13

concept relation

relation between *concepts* (3.4)(3.4)

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

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~~3.14~~ **3.14**

hierarchical relation

hierarchical concept relation

generic relation or partitive relation

[SOURCE: ISO 1087:2019, 3.2.12]

~~3.15~~ **3.15**

associative relation

associative concept relation

pragmatic relation

non-hierarchical *concept relation* ~~(3.13)~~ ~~(3.13)~~

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

[SOURCE: ISO 1087:2019, 3.2.23]

~~3.16~~ **3.16**

equivalence relationship

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

~~(3.4)~~ ~~(3.4)~~

~~3.17~~ —

~~3.17~~

concept system

system of concepts

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

[SOURCE: ISO 1087:2019, 3.2.28]

~~3.18~~ **3.18**

glossary

terminological dictionary that contains *designations* ~~(3.6)~~ ~~(3.6)~~ from one or more *domains* ~~(3.22)~~ ~~(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~~ **3.19**

classification scheme

descriptive information for an arrangement or division of *objects* ~~(3.1)~~ ~~(3.1)~~ into groups based on criteria such as *characteristics* ~~(3.3)~~ ~~(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~~ **3.20**

taxonomy

type of hierarchy which deals with generalization/specialization relationships

[SOURCE: ISO/IEC 11179-32:2023, 3.2.0, modified — Note 1 to entry deleted]

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3.21 3.21**terminology**

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

[SOURCE: ISO 1087:2019, 3.1.11]

3.22 3.22**subject heading scheme****subject heading language****subject heading list****SHL**

structured *vocabulary* (3.10)(3.10) comprising *terms* (3.4)(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 3.23**thesaurus**

controlled vocabulary (3.11)(3.11) and structured *vocabulary* (3.10)(3.10) in which *concepts* (3.4)(3.4) are represented by *terms* (3.9)(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 3.24**ontology**

collection of *terms* (3.9)(3.9), relational expressions and associated natural-language *definitions* (3.8)(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

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~~

~~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 1087:2019. 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 diagram shown in ~~Figure 1~~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.

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