What does “term meaning” mean?

Gulliver’s Travels
by Jonathan Swift (1667-1745)

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- Domains of interest: Artificial Intelligence, Linguistics, Digital Humanities, Knowledge Representation, Terminology, Ontology, Ontotermology

- Chairman of the TOTH Conferences
- Chairman of the AFNOR Commission on Terminology (X03A)
- Project Leader of the ISO Standards on Terminology (ISO 1087-1 & ISO 704)

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Terminology Coordination Unit: Interview with Christophe Roche

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“[…] since words are only names for things, it would be more convenient for all men to carry about them such things as were necessary to express the particular business they are to discourse on”

“Gavagai” in “Word & Object”, Quine
Meaning depends on:
- the intention of the speakers
- knowledge about the world
What does “term meaning” mean?
What is a term?

A term is a word or expression with a specific meaning, especially one which is used in relation to a particular subject. **Collins**

A word or phrase used to describe a thing or to express a concept, especially in a particular kind of language or branch of study. **Oxford Dictionary**

*verbal designation of a general concept in a specific subject field.*

**ISO 1087-1**
What is a term?

✓ It is a word  microscope  μικροσκόπιο

✓ It is a lexical unit  electron microscope

✓ But not any lexical unit

✓ A lexical unit which designates a specialized knowledge

✓ Is any lexical unit designating a specialized knowledge a term?
The terminology of a subject is the set of special words and expressions used in connection with it.

Collins

The body of terms used with a particular technical application in a subject of study, profession, etc.

Oxford

special words or expressions used in relation to a particular subject or activity

Cambridge
Terminology

- “set of designations belonging to one special language” [ISO 1087-1]

- “science studying the structure, formation, development, usage and management of terminologies in various subject fields” [ISO 1087-1]

  a term is a “verbal designation of a general concept in a specific subject field” [ISO 1087-1]
Terminology work is multidisciplinary and draws support from a number of disciplines (e.g. logic, epistemology, philosophy of science, linguistics, translation studies, information science and cognitive sciences) in its study of concepts and their representations in special language and general language. It combines elements from many theoretical approaches that deal with the description, ordering and transfer of knowledge.
The terminology work dealt with in this International Standard is concerned with terminology used for unambiguous communication in natural, human language. The goal of terminology work as described in this International Standard is, thus, a clarification and standardization of concepts and terminology for communication between humans. Terminology work may be used as input for information modelling and data modelling, but this International Standard does not cover the relation with these fields.
What does “term meaning” mean?

Gulliver’s Travels
by Jonathan Swift (1667-1745)
What is the meaning of a term?

‘Must a name mean something?’ Alice asked

“When I use a word,’ Humpty Dumpty said in rather a scornful tone, 'it means just what I choose it to mean—neither more nor less.'

'The question is,' said Alice, 'whether you CAN make words mean so many different things.'

'The question is,' said Humpty Dumpty, 'which is to be master—that's all.'
Meaning?

“the thing one intends to convey especially by language” Merriam-Webster

“What is meant by a word, text, concept, or action” Oxford *living* Dictionaries

“The meaning of a word, expression, or gesture is the thing or idea that it refers to or represents and which can be explained using other words” Collins

“The meaning of something is what it expresses or represents” Cambridge
What is the meaning of a term?

The concept denoted by the term?
(definition of name)

The definition of the concept denoted by the term?
(definition of thing)

The meaning of the term in discourse?
(definition of word)
2 types of term definition

Lexicographic definition (*definition of word*)

- the definition (meaning, signified) of the term built in discourse?
- standardized signified?
- definition in a natural language of the denoted object?

Terminological definition (*definition of thing*)

The definition of the concept denoted by the term
by C. K. Ogden and I. A. Richards (1923)
A **term** is a “verbal designation of a **concept**” ISO 1087-1

**Concept?**

**Concept name** *versus* **Term** ?
Double dimension of Terminology

 Terminology

 « There is no term without concept »

 Linguistic

 Conceptual

 Which language?
 - natural?
 - artificial?

The History of the Computer Mouse

Today, the mouse is an essential input device for all modern computers but it wasn’t so long ago that computers had no mouse and no graphical user interface. Data was entered by typing commands on a keyboard.

The mouse was invented by Douglas Engelbart in 1964 and consisted of a wooden shell, circuit board and two metal wheels that came into contact with the surface it was being used on.

It was 8 years later in 1972 that Bill English developed the design further by inventing what is known as the “Ball Mouse” that we know today. The ball replaced the wheels and was capable of monitoring movement in any direction. The ball came into contact with two rollers that in turn spun wheels with graduations on them that could be turned into electrical pulses representing direction and speed.

At the time Bill English was working for Xerox Parc (Palo Alto Research Centre) the research and development centre set up by Xerox to ‘design the future of computing’. The mouse became part of the ground breaking Xerox Alto computer system which was the first minicomputer system to offer a graphical user interface.
Double dimension of Terminology

“The Machine Tool: an Interlingual dictionary of basic concepts”  E. Wüster

guide bush(ing); guiding bush: A bushing (234) serving as guide (547, 528) for a cylindrical rotary element (209) which is subjected to very small radial stresses.

doûille de guidage; manchon pilote; bague de guidage: Coussinet en une pièce (234) servant de guide (547, 528) à un élément (209) cylindrique en rotation et soumis à des efforts radiaux très faibles.

Vide spec. fig. 915
guide bush(ing); guiding bush: A bushing (234) serving as guide (547, 528) for a cylindrical rotary element (209) which is subjected to very small radial stresses.
A term is a verbal designation of a concept

“chair”

<Seat for one person with feet with back without arm>
The meaning of a term is the definition of the concept denoted by the term.

Definition of “definition”?

In which language?
- natural language?
- formal language?

Are languages equivalent?

<Seat for one person with feet with back without arm>
::= <Seat> + /for one person/ + /with feet/ + /with back/ + /without arm/

> chair: seat for one person with feet woth back without arm
CONCEPTUAL ISSUES
Concept

Concept: Unit of knowledge

about a plurality of things

✓ Understanding the World
✓ Organizing the objects

/shared characteristics
/delimiting characteristics

/1 person/ /with feet/ /with back/

/with arms/ /without arms/
Conceptualization

**Conceptualize**: Form a concept or idea of (something). Oxford Dictionary.

**Conceptualize**: to form (a concept or concepts) out of observations, experience, data, etc. Collins

**Goals**:  
- To *understand* the world  
- To *put in order* the objects which populate the world
What do we need?
Understanding & Representing

Epistemological Principles ↔ Language of Representation
Understanding

Epistemological Principles
Epistemological Principles

Individual (object, thing)?

Concept?

Nature?

Class?

Property?

Characteristic?

Essential Characteristic?

Descriptive Characteristic?

Conceptual System?

Categories of Thought

Relations?

- generic/specific
- partitive
- associative
Epistemological Principles

As they are **perceived**
To **describe** objects

As they are **thought**
To **define** concepts
Concept:  Unit of knowledge created by a unique combination of characteristics [ISO 1087-1]

Characteristic: abstraction of a property of an object or of a set of objects

Delimiting characteristic: essential characteristic used for distinguishing a concept from related concepts
ISO Epistemological Principles

3.2.20
hierarchical relation
relation between two concepts (3.2.1) which may be either a generic relation (3.2.21) or a partitive relation (3.2.22)

3.2.21
generic relation
genus-species relation
relation between two concepts (3.2.1) where the intension (3.2.9) of one of the concepts includes that of the other concept and at least one additional delimiting characteristic (3.2.7)

3.2.22
partitive relation
part-whole relation
relation between two concepts (3.2.1) where one of the concepts constitutes the whole and the other concept a part of that whole

3.2.23
associative relation
pragmatic relation
relation between two concepts (3.2.1) having a non-hierarchical thematic connection by virtue of experience
Representing

Language of Representation
Languages of Representation

There is no knowledge without language

☑ Natural Language

the force of attraction or repulsion acting along a straight line between two electric charges is directly proportional to the product of the charges and inversely to the square of the distance between them

☑ Artificial Languages

$$\vec{F}_{1\rightarrow 2} = \frac{q_1 q_2}{4\pi \epsilon_0 \| \vec{r}_{12} \|^2} \cdot \frac{\vec{r}_{12}}{\| \vec{r}_{12} \|}$$

Categories of Language
Languages of Representation

- Experts
  - conceptualize
  - Ontology (expert)

- Texts
  - linguistic analysis
  - translation
  - validation

- Lexical Structure
  - Ontology (textual)
  - Conceptual Structure
Natural language *versus* Formal languages

Saying is not Modelling

- 2 different and linked semiotic systems handled by different rules
- The lexical structure and the conceptual structure do not match

The discourse on knowledge should not be confused with knowledge itself
Graphical Notation

✓ Easy to use

✓ Human Readable

✓ Semi-Formal

- Categories of thought?
- Methodology?
- Coherency?
- Operationalization?
Graphical Notation

ISO Graphical Notation

[ISO 1087-1]
[ISO 704]

**Generic relations**
are represented by tree diagrams

**Multidimensional subdivision:**
*criteria of subdivisions*
are represented by thicker lines

**Partitive relations**
are represented by rake diagrams

multiple part  single part
Graphical Notation

ISO 704

ISO 24156-1: Graphic notations for concept modelling in terminology work
Part 1: Guidelines for using UML notation in terminology work
Formal Language

Syntax and Semantics:

✓ Clear
✓ Precise
✓ Formally specified

Properties of Axiomatic System

Definitions are:

- Objective  - Consensual  - Readable (for an expert)
- Coherent   - Reusable
- Precise    - Sharable
Artificial Intelligence

Schema (Frame) - Minsky

Define the object structure

A class is defined as a set of slots with values

(defun-class lamp
  (is-a 'lighting-object)
  (space 'inside)
  (has-part 'chamber 'beak 'base))

Clear, powerful, readable both by human and computer
A concept is a well formed formula

Definition:

\[ \text{Pocket-Watch}(x) ::= \text{Time-Piece}(x) \land \text{Portable}(x) \land \text{Pocket}(x) \]

Properties:

\[ \models \neg (\text{Pocket}(x) \land \text{Wrist}(x)) \]

Reasoning:

\[ \text{Portable}(x) \implies (\text{Wrist-Watch}(x) \lor \text{Pocket-Watch}(x)) \]

Computer readable:

Description Logic

Logic is necessary
Which Language?

✗ The expression of knowledge is limited to the well formed formulas of the theory

✗ The formal languages are not equivalent

*The Sapir-Whorf’s hypothesis is true for all languages*

- *Power of expression: categories of thought supported by the categories of the language*
- *Logical Properties*
- *Operationalization*
Which Language?

Epistemological Problems

✗ Logic

Man(x), Reasonable (x), Sick(x)

✗ Frame Languages
Which Language?

- Use a language whose categories of language support the categories of thought
- Use a formal and computer-readable language

Interest?

- ✓ Objective definitions
- ✓ Constructive definitions
- ✓ Operationalization

⇒ Ontology
ONTOLOGY
Ontology

Knowledge Engineering

“A specification of a conceptualization” T. Gruber

A definition in a formal and computer readable language of a set of concepts and of their relationships

- **<Timepiece>**
  - **<Clock>** (non portable)
  - **<Watch>** (portable)
    - **<Wrist watch>** (wrist)
    - **<Pocket watch>** (pocket)
  - **<Movement>**
    - **<Electronic movement>** (electronic)
    - **<Mechanical movement>** (mechanical)
Operational Language

IT Applications of Terminology:

✓ Semantic (Multilingual) Search Engine
✓ (Multilingual) Content Management Systems
✓ (Multilingual) Specialized Encyclopedias
✓ Knowledge Capitalization
✓ Semantic web
Ontology

Mikrokosmos

form(x) = independant(x) \land \text{abstract}(x)
ONTOTERMINOLOGY
Ontology + Terminology

Terminology

« There is no term without concept »

Linguistic

Conceptual

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Ontology + Terminology

**Ontotermology**: a terminology whose conceptual system is a formal ontology

- multilingualism
- linguistic diversity
Double Semantic Triangle

A term is given
A concept name is built: Chinese is a suitable language for building neoterm
Ontoterm

Definition of thing (concept)
- ontological
- formal
- constructive (operationalization)

Definition of name
"term"

Definition of word (term)
- explanation in natural language
- connotative information
Ontotermology

« Ontotermology standardizes the only thing that can be standardized, namely knowledge of the field, and preserves what must be preserved, namely linguistic diversity »

« If a conceptualization is worded in natural language, it is defined in a formal language guided by epistemological principles »
CONCLUSION

There is no Terminology without a Concept Theory

✓ Essential Characteristic
✓ Descriptive Characteristic
✓ Concept: combination of essential characteristics
✓ Relation
CONCLUSION

How to represent essential characteristic in an A.I. language?

```lisp
(defun-class class
  (slot value)
  (slot value)
  ...
)
```

```lisp
(defun-class lamp
  (is-a ‘lighting-object)
  (space ‘inside)
  (has-part ‘(chamber ‘beak ‘base)) ...
)
```

```lisp
(defun-class lamp
  (is-a ‘lighting-object)
  (essential-characteristic-list ‘(inside)
   (has-part ‘(chamber ‘beak ‘base)) ...
)
```
How to represent essential characteristic in a Logic language (Protégé)?

\[
\text{Lamp}(x) ::= \text{LightingObject}(x) \land \text{InsideSpace}(x)
\]

\[
\text{Lamp}(x) \rightarrow \exists y,z,t \ / \ \text{Chamber}(y) \land \text{HasPart}(x,y) \land ...
\]

- Essential characteristic == Class
- Essential characteristic == individual
Part 2: Practice

- Environments: CmapTools, Protégé, Tedi
- Example
Example

Terminology of seats

扶手椅

armchair
fauteuil

椅子

canapé

长凳

stool

chair

banc

tabouret

bench

pouf

couch
<table>
<thead>
<tr>
<th>Definition of:</th>
<th>&quot;chaise&quot; in French</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;chair&quot; in English</td>
</tr>
<tr>
<td></td>
<td>&quot;椅子&quot; in Chinese</td>
</tr>
</tbody>
</table>
Definition of:  
- “chaise”? French
- “chair”? English
- “椅子”? Chinese

chair:

- A separate seat for one person, typically with a back and four legs (https://en.oxforddictionaries.com/)

- A chair is a piece of furniture for one person to sit on. Chairs have a back and four legs (https://www.collinsdictionary.com/).

- a piece of furniture for one person to sit on, with a back, legs, and sometimes two arms (https://www.macmillandictionary.com/)

- a seat for one person, with a support for the back (WordNet)
Definition of:  - “chaise” ? French  
    - “chair” ? English  
    - “椅子” ? Chinese

chaise:
- siège à dossier et généralement sans bras.
Example

Definition of:  - “chaise” ? French
               - “chair” ? English
               - “椅子” ? Chinese

椅子:
- 椅，无靠背的称为桿，是一件用來坐的家具，為腳物家具的一種，一般包括一個座位、椅背，有時還包括扶手，通常會有椅腳使座位高於地面。当椅子坐久后坐垫便会熱。
Example

Definition of:  
- “chaise” ? French  
- “chair” ? English  
- “椅子” ? Chinese

Terminology: the definition of a term is the definition of the concept denoted by the term expressed in a natural language.

How to define the concepts denoted by the terms “seat”, “chair”, “armchair”, “bench”, etc.? 

Theory of Concept for Terminology (C.T.T)

What is (are) the difference(s) between: 
- a chair and an armchair ?  
- a chair and a bench ?  
- a couch and a bench with back and arms ?  
- ...
Array of Differences

Essential characteristics:
- /one person/ or /several persons/
- /with feet/ or /without feet/
- /with back /or /without back/
- /with arms/ or /without arms/
- /for interior/ or /for exterior/
- /comfortable/ or /not comfortable/

Descriptive characteristics:
- material
- colour
- weight

Parts of:
- arm
- feet
- back

Properties:
- no arms without back
Tools & Environments

CmapTools
knowledge modeling kit
Version 5.04.01
Institute for Human and Machine Cognition
A University Affiliated Research Institute
http://cmap.ihmc.us

protégé

TEDI
ontotermology editor

By clicking accept you agree to the TEDI license agreement

© Christophe Roche
Concept maps are graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts. (http://cmap.ihmc.us/docs/theory-of-concept-links.php)
Cmap software is a result of research conducted at the Florida Institute for Human & Machine Cognition (IHMC). It empowers users to construct, navigate, share and criticize knowledge models represented as concept maps.

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Epistemological Principles

**Concept:** Concept as a perceived regularity in events or objects, or records of events or objects, designated by a label.

**Proposition:** Propositions are statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected using linking words or phrases to form a meaningful statement.

Representation

**Concept:** Node

**Proposition:** labeled link
Conceptual System
Lexical Network

T-hyponym

'siège'

'tabouret'

'fauteuil'

'pouf'

'canapé'

'chaise'

'banc'
Protégé

Protégé is a free, open source ontology editor and a knowledge management system. Protégé provides a graphic user interface to define ontologies. It also includes deductive classifiers to validate that models are consistent and to infer new information based on the analysis of an ontology. Like Eclipse, Protégé is a framework for which various other projects suggest plugins. This application is written in Java and heavily uses Swing to create the user interface. Protégé recently has over 300,000 registered users.[4] According to a 2009 book it is "the leading ontological engineering tool".[5]

Protégé is being developed at Stanford University and is made available under the BSD 2-clause license.[6] Earlier versions of the tool were developed in collaboration with the University of Manchester.
Protégé
Tedi is a software environment dedicated to ontoterminology building providing several specialized editors.
Ontology relies on a Concept Theory

Tedi is based on the **C.T.T.** (Concept Theory of Terminology)

**CTT epistemological principles:**
- essential characteristic
- descriptive characteristic
- axis of analysis
- concept
- relation

**CTT logical properties**
Concept editor: Organizing concepts

- Explicit name of concept
- Inferred and declared generic concepts
- Inherited and declared essential characteristics
- Inherited and declared descriptive characteristics
- Relations
- Terms
Term Editor

Term List:
- banc
- bergère
- canapé
- chaise
- chaise d'intérieur
- fauteuil
- pouf
- siège
- tabouret

Term: chaise

Term definition:
Siège pour une personne sans bras avec pieds et dossier.

Source: GE

Contacts:

Notes:
Siège à dossier et généralement sans bras. Source: TLFI 31/05/2017

Orthographic variations:
- chaise

Inflected forms:
- chaises

T. Equivalent terms:
- on: chair
  - gr: kopčíčka

T. Hypernyms:
- siège (preferred)

T. Hyponyms:

T. Synonyms:
- chaise d'intérieur (alternative)

T. Linked terms:

Denoted Concept List:
- Siège une personne avec pieds dossier et sans bras

Concept definition in Natural Language:
une personne, siège, avec pieds, sans bras, avec dossier.

Comment:

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Différents formats d’export :
- Échange et partage d’ontotermologies ;
- Exploitation pour différentes applications ;
- CSV (Cmap), HTML (navigateurs), RDF/OWL (Protégé), JSON, OTE (Tedi viewer), SKOS
<Siège une personne>  
<Siège> subconcept  <Siège une personne>  
<Siège une personne avec pieds dossier et sans bras>  
<Siège une personne avec pieds> subconcept  <Siège une personne avec pieds dossier et sans bras>  
<Siège une personne sans pieds sans dossier et sans bras>  
<Siège une personne> subconcept  <Siège une personne sans pieds sans dossier et sans bras>  
<Siège sans pieds> subconcept  <Siège une personne sans pieds sans dossier et sans bras>  
<Siège une personne avec pieds> subconcept  <Siège une personne avec pieds>  
<Siège plusieurs personnes avec pieds>  

CmapTools
knowledge modeling kit

Version 5.04.01

<Siège>

subconcept

<Siège plusieurs personnes avec pieds>

subconcept

<Siège plusieurs personnes avec pieds dossier et bras>

<Siège plusieurs personnes avec pieds sans bras sans dossier>

<Siège une personne avec pieds>

subconcept

<Siège une personne avec pieds dossier et sans bras>

<Siège une personne avec pieds sans dossier et sans bras>

<Siège une personne>

subconcept

<Siège une personne sans pieds sans dossier et sans bras>

<Siège une personne sans pieds>

subconcept

<Siège une personne sans pieds dossier et sans bras>
CSV Format

Comma-Separated Values

' banc'
'tabouret'
'chaise'
'siège'
'siège' T-hyponym
'siège' T-hyponym
'siège' T-hyponym
'siège' T-hyponym
'canapé'
'fauteuil'
'pouf'
'banc'
'canapé'
'chaise'
'fauteuil'
'pouf'
'tabouret'

T-hyponym

'siège'

'pouf'  'banc'

'canapé'

'fauteuil'

'chaise'

'tabouret'

'pouf'
Protégé (OWL)
chaise

Definition: Siège pour une personne sans bras avec pieds et dossier.
Status: preferred
Source: OE
See also: chaise d'intérieur (alternative),
Context(s):
1) "Les cafés à l'entour avaient depuis longtemps couché sur leurs tables de marbre leurs chaises tendrement rabotées par des derrières peu soucieux de voyages. QUENEAU, Pierrot mon ami, 1942, p. 199." Source : TLFI 31/05/2017
Note(s):
1) Siège à dossier et généralement sans bras. Source : TLFI 31/05/2017

Equivalent(s):
- en chair
- cn 椅子

Concept: <Siège une personne avec pieds dossier et sans bras>
essential characteristic(s): /sans bras/, /avec dossier/, /une personne/, /siège/, /avec pieds/,
a kind of: <Siège une personne avec pieds>,
linked to: <Dossier>, <Pied>.

Web reference: Le grand salon de l'Impératrice au château de Fontainebleau du temps de l'Impératrice Eugénie
Illustration: Chaise, 1809, bois peint. Versailles, musée national du château, T 507 C.

Video: Une visite au Louvre
CONCLUSION

The definition of term is the definition of the concept denoted by the term

- Dedicated Concept Theory
- Software Environment
- Methodology