

Terminology in ontologies and other lexicographic resources

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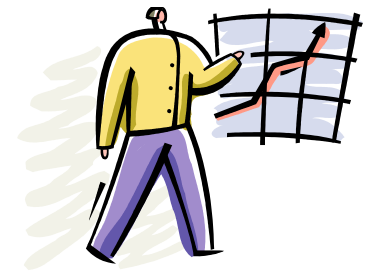
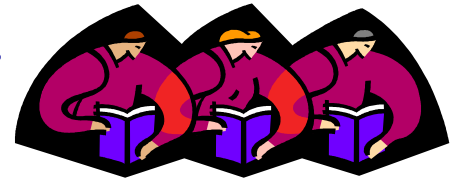
Outline

- What is terminology?
- Terminology in scientific domains
- Object of study of terminology
- Concepts and their relations
- Terms and their formation
- Linguistic resources and ontologies
- Reusing non ontological resources
- Final remarks

What is terminology?

The term terminology is polysemic:

- As a **product**: set of terms from a given subject field.
- As a **discipline**: set of fundamental principles and conceptual bases that govern the study of specialized terms, their description, analysis and relations.
- As a **practice**: set of guidelines oriented towards term compilation and organization

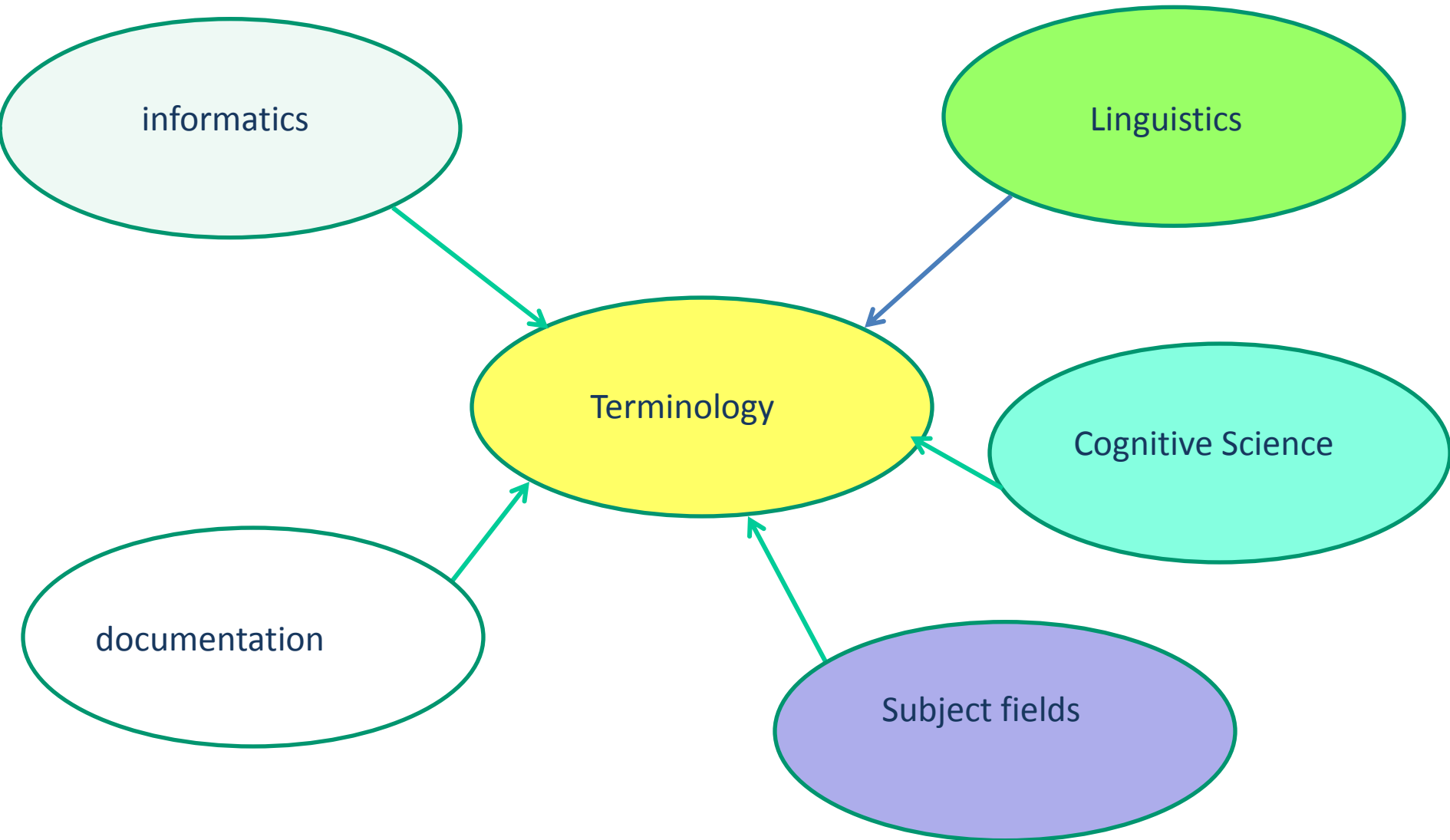


Terminology in technical & scientific domains

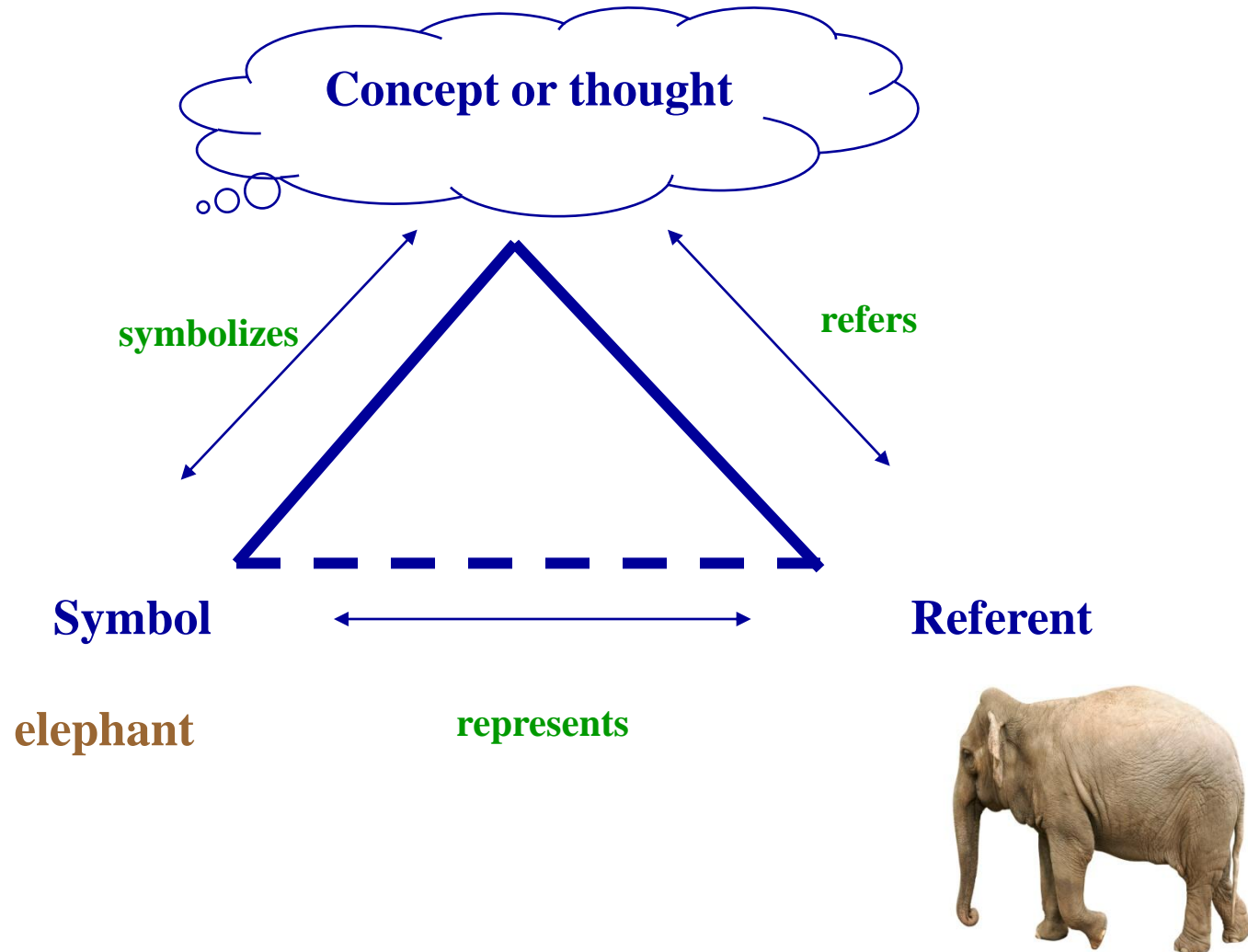
- No **professional communication** can exist without terminology
- No **knowledge transfer** can exist without terminology
- Without terminology there is not
 - Intellectual and material **development**
 - Professional **research and training**
- As a **consequence**,
 - no further development would take place
 - A country would isolate from the rest of developed countries

(Picht, 1979)

Terminology: interdisciplinary subject field



Semantic triangle by Ogden & Richards



Object of study in terminology

- Concepts
- Terms
- Relation between terms and concepts
- Definitions (not included in this lesson)

NOWADAYS

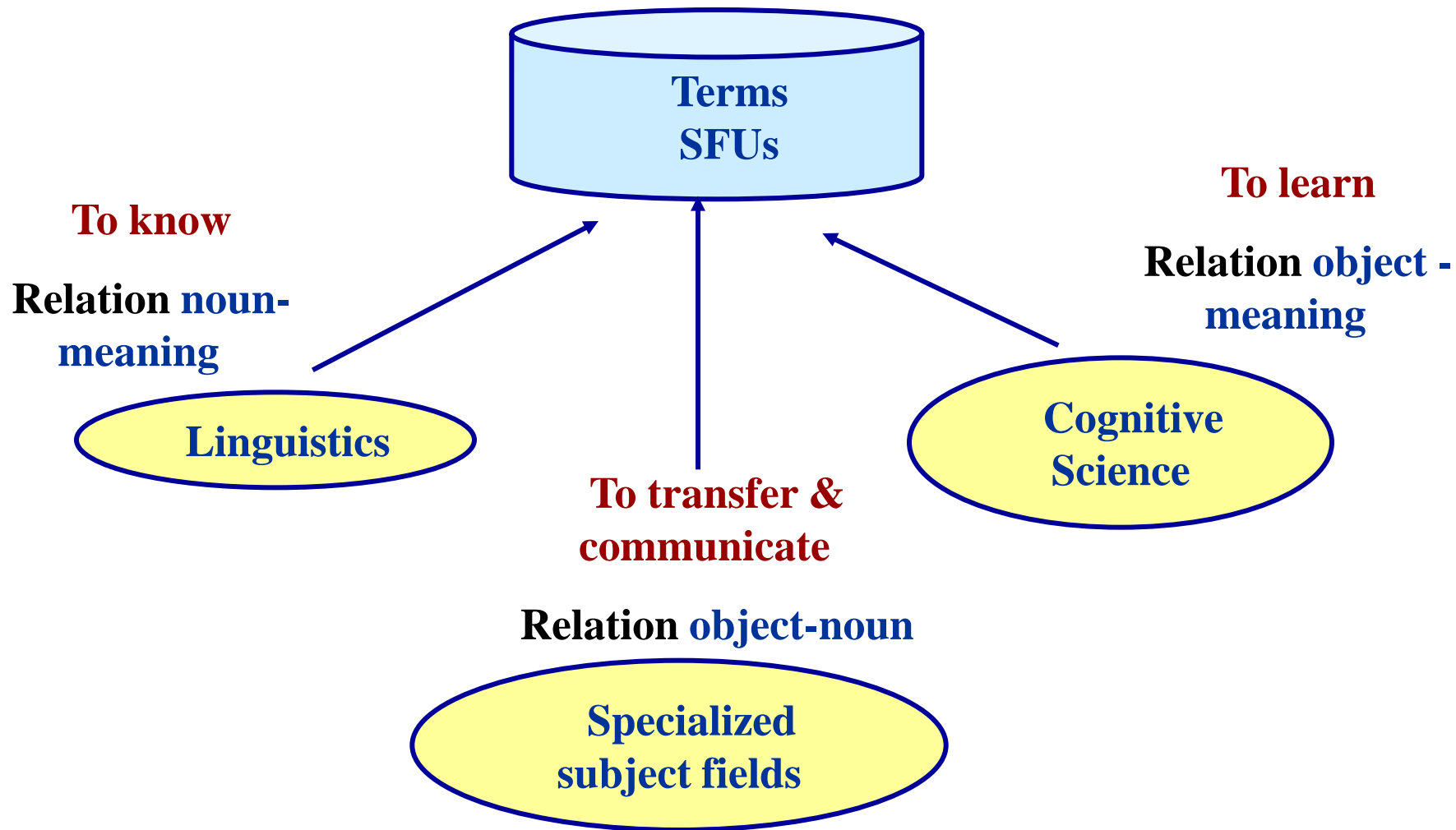
- Emphasis on terminology management:
 - products, tools and applications

The object of study of terminology (1)

- identifying concepts and concept relations
- analysing and modelling concept systems on the basis of identified concepts and concept relations
- establishing representations of concept systems through concept diagrams
- defining concepts
- attributing designations (predominantly terms) to each concept in one or more languages
- recording and presenting terminological data, principally in print and electronic media (terminography)

ISO FDIS 704 :2009

The object of study of terminology (2)



Definition of a concept

- *In general*: Unit of knowledge created by a unique combination of characteristics. ISO 1087- 1 (2000)
- *In terminology*: Concepts shall be considered mental representation of objects within a *specialized context or field* ISO/DIS 704 (2009)
- **BUT** concepts are influenced by social and cultural circumstances given at a certain moment
 - **SO** this can lead to different classifications in the conceptual system
- **Concepts** can be seen as:
 - Units of **thought**: represent and recognize the object mentally
 - Units of **knowledge**: represent knowledge in each subject field
 - Units of **communication**: transmit knowledge by means of linguistic symbols

Description of a concept

- Concepts are described according to their common **features**, **properties** or **characteristics**, either by intension or extension
- **Intension**
 - Set of characteristics which makes up the concept (ISO 1087-1: 2000)
 - The bigger the number of common characteristics, the more restricted is the intension.
 - The intension of the concept **winter** in polar countries includes: low temperatures, ice, wind, snow, etc.
- **Extension**
 - Totality of objects to which a concept corresponds (ISO 1087-1: 2000)
 - A general concept has a wide extension as it includes two or more objects by reason of common properties.
 - The extension of the concept **planet** includes: *Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.*

Characteristics of a concept

- “Abstraction of a property of an object or of a set of objects” (ISO 1087-1:2000)
- According to the **importance** in forming a concept
 - **essential**: indispensable to understand and distinguish a concept
 - *The back of a seat distinguishes a stool and a chair.*
 - **complementary**: *colour, material, shape, ...*
- According to the **relation** with the object represented
 - **intrinsic**, which are observable properties:
 - **Shape**: oval, round, narrow, wide, ...
 - **Material**: wooden, stone, metallic, ...
 - **Colour**: red, blue, green, orange...
 - **Position**: vertical, hanging, slanting
 - **extrinsic**, relation of the object with others
 - **Mode of employment** or application: *analogic, digital, hybrid.*
 - **Origin** or how an object comes into existence: producer, inventor, provider, the place of its production, (town, country), ...



Concept: abstraction based on the set of all the characteristics
of mechanical mice
Term: mechanical mouse



- a device;
- ivory-coloured;
- hand-manoeuvred along a firm, flat surface;
- has a ball on its underside;
- has three buttons;
- has a wire for connecting to a computer;
- rollers detect the movement of the ball;
- the ball controls the movement of a cursor on a computer display screen.



- a device;
- blue and grey;
- hand-manoeuvred along a firm, flat surface;
- has a ball on its underside;
- has two buttons;
- has a wire for connecting to a computer;
- without rollers;
- the ball controls the movement of a cursor on a computer display screen.



- a device;
- black-grey;
- hand-manoeuvred along a firm, flat surface;
- has a ball on its underside;
- has two buttons;
- has a wire for connecting to a computer;
- rollers detect the movement of the ball;
- the ball controls the movement of a cursor on a computer display screen.



ISO FDIS 704:2009

Relations between concepts: hierarchical relations

Close relation between a concept and its characteristics

A. **GENERIC RELATIONS** (**genus-species** relation) **IS_A**

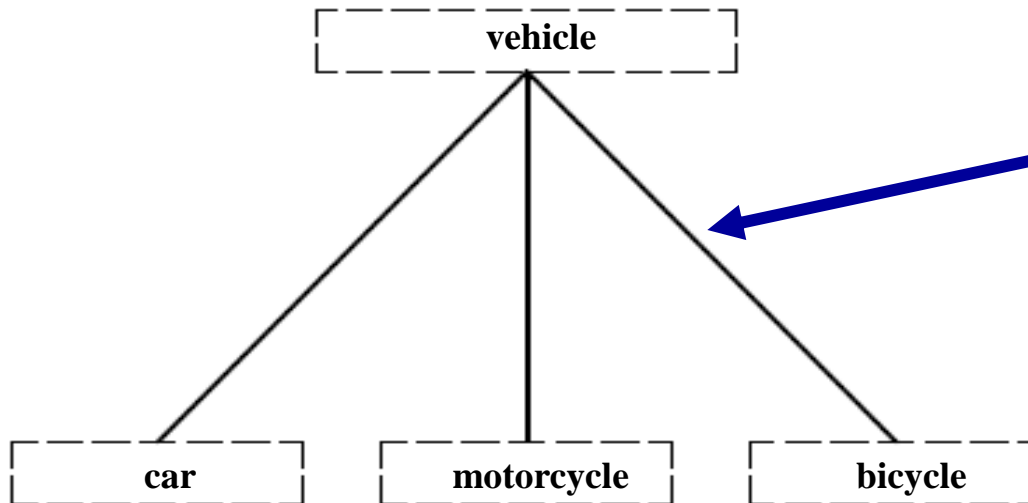
- One of the concepts includes another concept
 - **vertical:** hypernym- hyponym; superordinate –subordinate
 - **horizontal:** two specific ideas of the same generic concept with some distinguishing characteristics
- In thesaurus
 - *Broader than* (BT)
 - *Narrower than* (NT)
 - *Associated to* (AT)



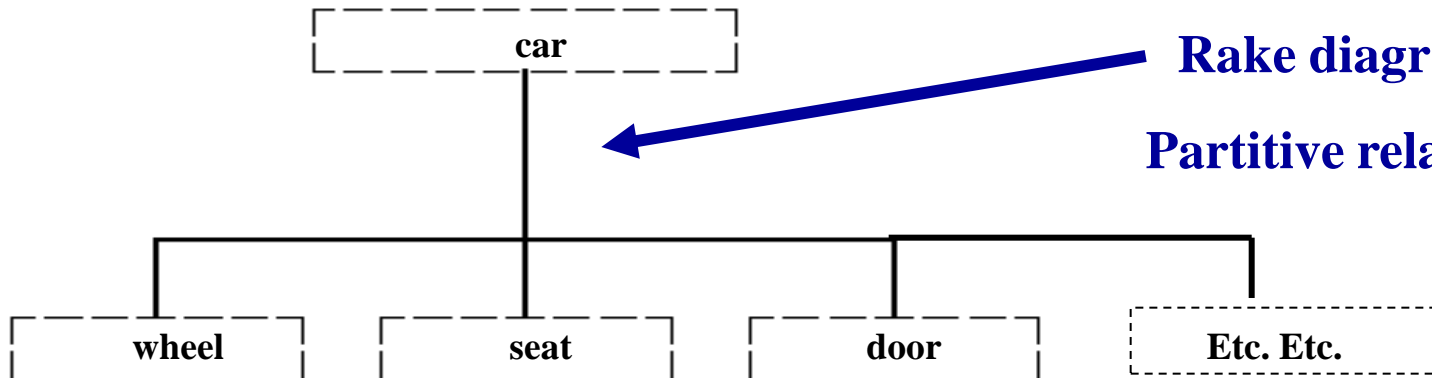
B. **PARTITIVE RELATIONS** (**part-whole** relation) **PART_OF**

- These relations are also called **meronimic** (**HAS_PART**)
 - *Car: wheels, seats, doors, boot, steering wheel, gearbox...*
- Different types of meronimic relations

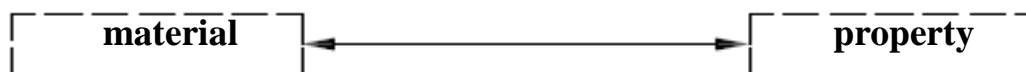




Tree diagram
Generic concept relations



Rake diagrams
Partitive relations

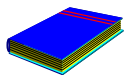


Line with arrowheads
Associative relations

Other Meronymic Relations

Relación	Ejemplo
componente - objeto	<i>pedal - bicicleta</i>
miembro - colección	<i>barco - flota</i>
porción - masa	<i>rebanada - pan</i>
material - objeto	<i>acero - coche</i>
fase - actividad	<i>pagar - comprar</i>
lugar - área	<i>oasis - desierto</i>

Tabla II.2: Modelo de Winston *et al.* (1987)



Climent, S. 1999 *Individuación e información parte-todo. Representación para el procesamiento computacional del lenguaje*

Non-hierarchical relations (associative relations)

- *Caused by* : (acid rain- nuclear explosion)
- *Product of*: (paper- wood pulp)
- *Property of* (compressibility -gas)
- *Quantitative measure* (temperature-heat)
- *Instrument for* (computer- data processing)
- *Counter-agent for* (insecticide- insects)
- *Container of* (toolbox- tools)
- *Method of* (diamond drilling- drilling)
- *Material for* (iron-bridge building)
- *Place for* (coal mine- coal exploitation)
- *Associated with* (production-consumption)

An *associative relation* exists when a thematic connection can be established between *concepts* by virtue of experience.

How do we express concepts?

- In **natural language** :
 - Terms (one-word or multi-word terms) that denote or refer to a concept in a subject field
 - Definitions
 - Glosses, etc.
- In **artificial language**
 - Codes
 - Formulas
- In a **multimedia resource**:
 - Icons
 - Photos
 - Diagrams
 - Graphs
 - Video-clips
 - Audio-clips
 - Other multimedia representations

Term formation I

- According to its **origin**:
 - **Borrowings from other languages**: *hardware, software, football, cookies, folksonomies*
 - **Adapted borrowings**: *formatear, inicializar, fútbol, etc.*
 - **Loans of structure** : *inteligencia artificial, lógica difusa, programación orientada a objetos, anotación social, kindergarten= jardín de infancia*
 - **Semantic loans**: *aplicación, utilidades, editar, icono, ratón, menú, semantic **grid***
 - **Transliteration**: Pekin- Beijin
- According to its **formation**:
 - **One-word terminological units** : *Programa, aplicación, icono, menú, ratón*
 - **Multiword terminological units** : *programming language, computer assisted design/learning, high level language, object-oriented programming*

Term formation II

- According to its **components**:
 - **Suffixation**:
 - *teca/tica*: *animática, burótica, indumática, ofimática, robótica, telemática, turística*
 - *ware*: *hard-, soft-, middle-*,
 - *itis*: a) inflamación: *bronquitis, faringitis, amigdalitis, otitis*
- b) obsesión: *madriditis, mamitis, futbolitis*
 - **Prefixation**: *ciber*: *cibercoffee, cibermedicine, cibercrime, etc*
 - **Composition**: *screensaver = salvapantallas, reposapiés = footrest,*
 - **Abbreviation (acronyms)**: *PC, PDF, TCP/IP, blog, MP3, wysiwyg,*
 - **Conversion**: *download, input, output, fax-to fax*
 - **Neologization**: *to twitter, to google, autoedición, “gustomizar”,*
 - **Metaphorization**: *cloud computing, folksonomies, social tagging, surf the net, tag cloud, paquete de mejoras salariales, autopistas de la información, papelera, escritorio, bajar de la red, machacar un fichero, caerse el sistema, etc*

Relations between denomination and concept

- **Synonymy**: the quality of two or more words with the same or similar meaning:
 - *Contamination = pollution; store = save a file, run = process*
- **Polisemy**: the capacity for a word(s) or a sign to have multiple meanings.
 - *Cluster*
- **Homonymy**: The quality of a word or group of words that share the same spelling but have different meanings, usually because they have different origins:
 - *Desert (leave), desert (arid region)*
 - *Bear (animal), bear (verb)*
 - *Fluke :*
 - *A fish, and a flatworm*
 - *The end parts of an anchor*
 - *The fins on a whale's tail.*
 - *A stroke of luck*

Relation between denomination and concept:

Synonymy in terminology

Conceptual
Content

A

Expression

X

Y

Z

1. an acronym and the complete terminological unit:

UCP: Unidad central de proceso

2. An acronym that represents the English term and the complete term in Spanish:

CPU: unidad central de proceso

LAN : red de área local

3. An abbreviated form and the complete term:

un mini: un miniordenador

una macro: una macroinstrucción

4. A scientific denomination and the popular one:

chip: circuito integrado

5. A standardised term and the dialectal variant

hormigón in Spain and concreto in South America

array, matriz in Spain y arreglo in South America

6. Symbols and their terms

Ca = Calcio

7. Variants of a term:

tecla de borrar = tecla de suprimir

menú de persiana = menú desplegable

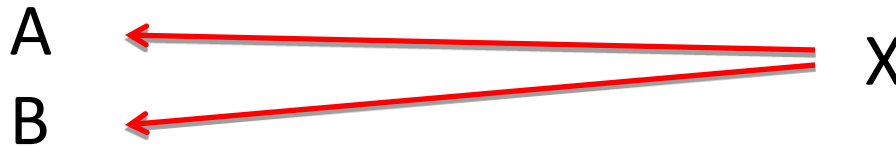
Collaborative tagging, social

classification, social indexing, social tagging

Relation between denomination and concept: Polisemy in terminology

Conceptual
Content

Expression



1. A group of loosely coupled computers that work together closely (HW)
 2. A group of disk sectors used in a File Allocation Table (SW)
- Cluster
(Comp.)
-
- A diagram illustrating the concept of polisemy. On the right, under the 'Expression' column, is the text 'Cluster (Comp.)'. On the left, under the 'Conceptual Content' column, are two numbered items. Two red arrows originate from 'Cluster (Comp.)' and point to the two numbered items respectively, indicating that the same expression 'Cluster (Comp.)' can refer to multiple different conceptual contents.

Water in different concept systems

Chemistry

- molecule-composed compound of two atoms of hydrogen and one atom of oxygen (H_2O), considered the universal solvent

Physics

- fluid which is colourless, odourless and tasteless used as the standard of specific gravity and of specific heat which freezes at 0°C and boils at 100°C

Physics

- chemical compound which is colourless, odourless, and tasteless and whose formula is H_2O and which is naturally found in solid state at temperatures at and below 0°C , in liquid state at temperatures between 0°C and 100°C , and as vapour at temperatures above 100°C

Biology

- chemical substance that is essential to all known forms of life

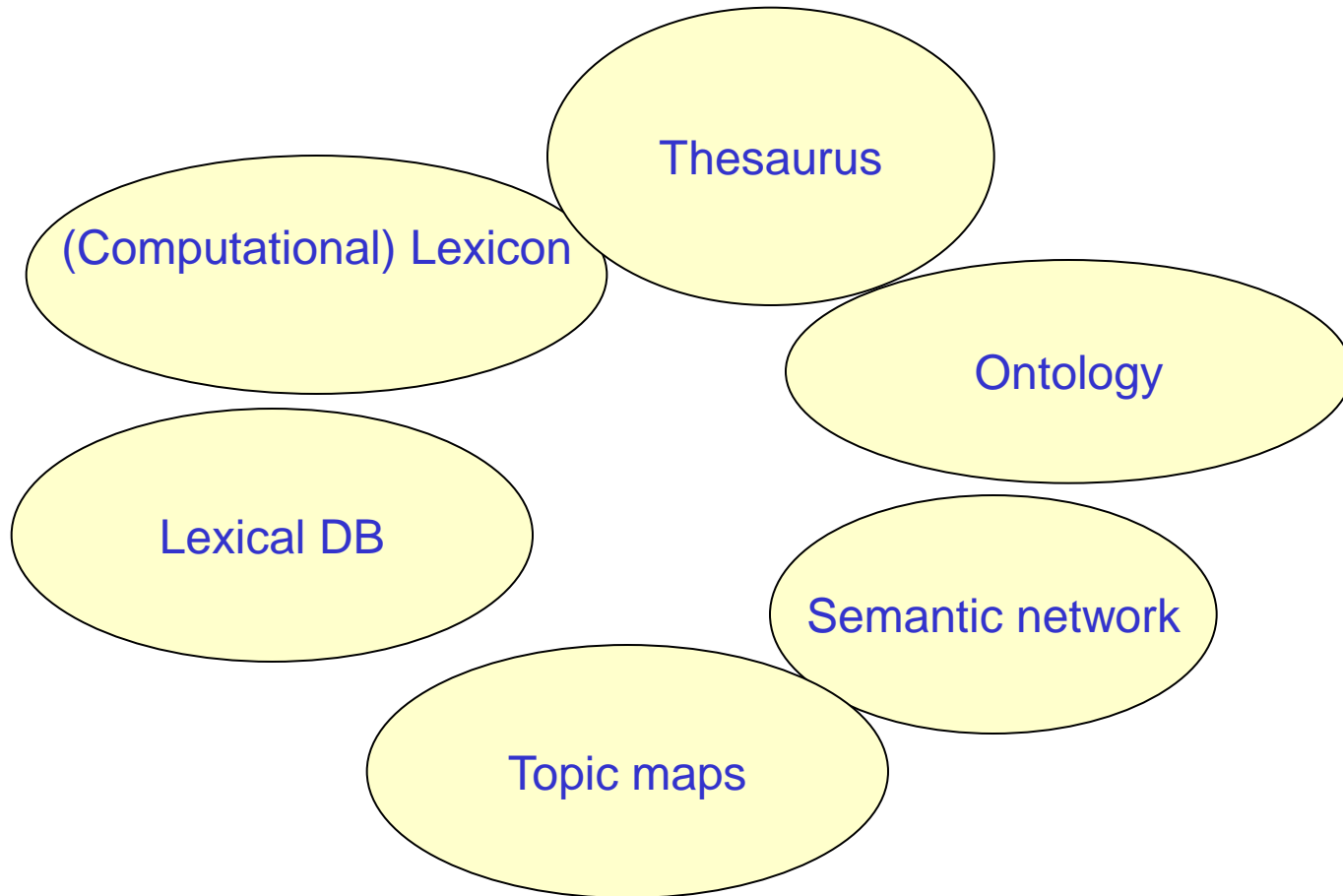
Metrology

- chemical compound whose freezing and boiling points are the basis for the Celsius temperature scale, where freezing point equals 0°C and boiling point equals 100°C at standard atmospheric pressure

Astrology

- one of the four elements of life that is associated with the emotional and intuitive processes

Linguistic and conceptual resources: terminological chaos?



Some definitions

- **Thesaurus**: Organized controlled vocabulary of terms and their relations (hierarchical, etc.) in a subject domain.
 - **Conceptual Model**: Information developed by several people to represent a data model that allows the storage , retrieval and manipulation of semantic relations between concepts and scopes that may exist in some domain.
 - **Lexical Model**: the semantics of the grammatical units and other kinds of information
- word-sense-entry** →
- **CONCEPT** : **ORTHOGRAHY** : string
 - **CONCEPT** : **WORD-MEANING** : word-meaning-id+
 - **CONCEPT** : **SYNONYMS** : word-meaning-id*
 - **CONCEPT** : **NEAR-SYNONYMS** : word-meaning-id*
 - **CONCEPT** : **HYPONYMS** : hyponym*
 - **CONCEPT** : **HYPERONYMS** : hyperonym*
 - **CONCEPT** : **ANTONYMS** : antonym*
 - **CONCEPT** : **MERONYMS** : meronym*
 - **CONCEPT** : **HOLONYMS** : holonym*
 - **CONCEPT** : **QUANTIFICATION** : quantification*
 - **CONCEPT** : **COLLOCATIONS** : collocation*
 - **CONCEPT** : **SEMANTIC-FRAME** : sem-frame
 - **CONCEPT** : **ACTIONALITY** : actionality
 - **CONCEPT** : **ENTRY-CREATOR**: (HUMAN | MACHINE)
 - **CONCEPT** : **IS_VALIDATED**: Boolean]

(phonologic, morphologic, syntactic, semantic and pragmatic) 

What is an ontology?

- “An ontology is similar to a dictionary or glossary, but with greater detail and structure that enables computers to process its content. (IEEE Standard Upper Ontology Working Group)
- “An ontology consists of a set of concepts, axioms, and relationships that describe a domain of interest.”
SUMO ontology <http://ontology.teknowledge.com/>

Classification

from an ontological perspective

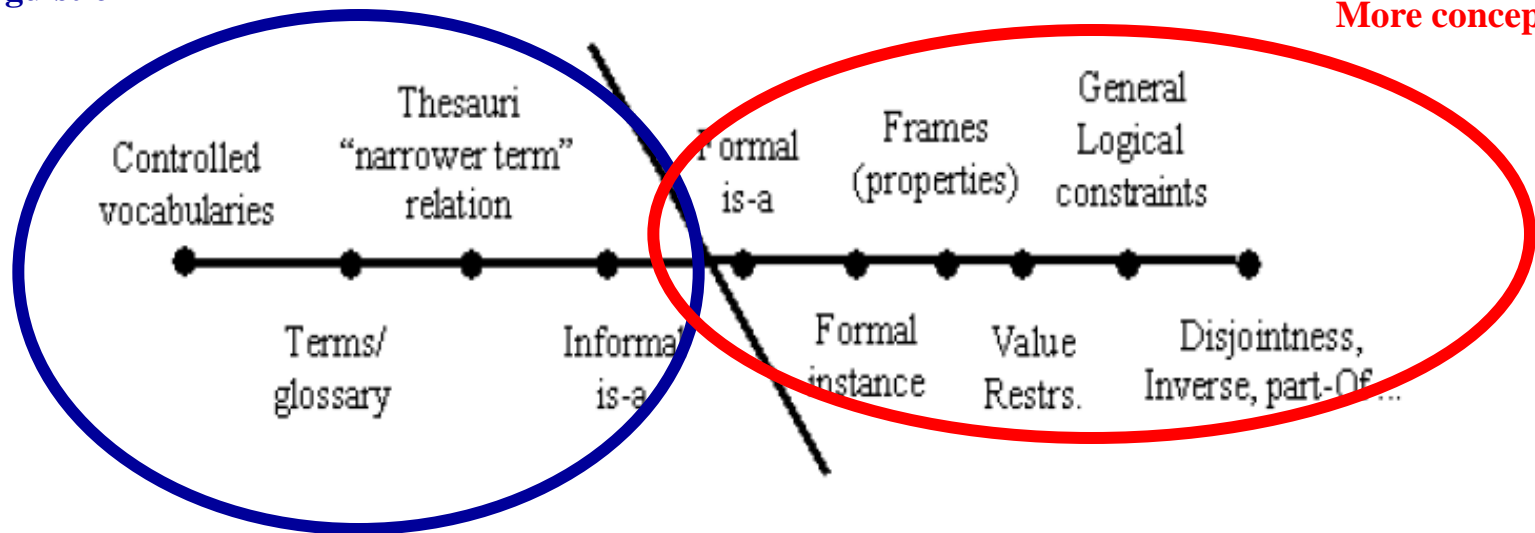
(Lassila & McGuinness)

Lightweight Ontologies

Heavyweight Ontologies

More linguistic

More conceptual



(Lassila & McGuinness, 2001)



- Gómez-Pérez, A., Fernandez-Lopez, M., Corcho, O. (2003) *Ontological engineering: with examples from the areas of knowledge management, e-commerce and the Semantic Web*. Londres:Springer Verlag London Ltd.

Glossaries

- List of terms, not always with definitions.
- Terms usually belong to a subject field
- Terms are defined according to the meaning in that field only

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List of all Topics

Alphabetical List of All Topics

This page organizes topics into alphabetical order, like a book's index. You can also browse topics organized into [broad categories, like a book's table of contents](#).

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A	Back to Top
Abandoned Mine	Ecosystems > Mines > Abandoned Mine
Abandoned Properties	Cleanup > Storage Tanks > Abandoned Properties
Abatement	Air > Air Pollution Control > Abatement
Abatement	Treatment/Control > Air Pollution Control > Abatement
Above Ground Tanks	Industry > Storage Tanks > Above Ground Tanks
Accident Preparedness	Emergencies > Accidents > Accident Preparedness
Accident Prevention	Emergencies > Accidents > Accident Prevention
Accidents	Emergencies > Accidents
Accomplishments	Cleanup > Accomplishments
Acetone	Pollutants/Toxics > Soil Contaminants > Acetone
Acid Rain	Air > Air Pollution Effects > Acid Rain
Acute Exposure	Human Health > Exposure > Acute Exposure
Administrative Civil Enforcement	Compliance And Enforcement > Civil Enforcement > Administrative Civil Enforcement
Administrator	Environmental Protection Agency > Administrator
Advisories	Human Health > Advisories
Advisory Committees	Environmental Protection Agency > Science Advisory Board (SAB) > Advisory Committees

CINDOC Glossary

[Tesauros](#)[Inicio](#)[Alfabético](#)[Búsquedas](#)

Glosario de Máquinas Herramienta

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Listado alfabético de terminos [#1] *(no-descriptores en cursiva)*

[1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [Siguiente] [Fin]

a prueba de empleo incorrecto
abrazadera para tubos
accionamiento de la mesa
accionamiento del avance
accionamiento eléctrico
accionamiento forzado
accionamiento hidráulico
accionamiento individual
accionamiento neumático
accionamiento por cuerda
accionamiento por fricción
accionamiento por grupos
accionamiento por poleas escalonadas
accionamiento por trinquete
aceleración
acoplador roscado para tuberías
acoplamiento de desembrague
acoplamiento de ejes

INSPEC Thesaurus

Type of data included

THESAURUS search words: **natural languages**

UF natural language processing (UF=used for natural language processing)

BT languages (BT=broader term is languages)

TT languages (TT=top term in a hierarchy of terms)

RT artificial intelligence (RT=related term/s)

computational linguistic
formal languages
programming languages
query languages
specification languages
speech recognition
user interfaces

CC C4210L; C6140D; C6180N; C7820(CC=classification code)

DI January 1985(DI=date [1985])

PT high level languages (PT=prior term to natural languages)

Equivalence
relation

Generic relation

Hierarchical relation

Specific relation

Associative
relation

Other data

An excerpt from INSPEC Thesaurus

Cellular radio	used for (UF): cellular communication cellular telephones Groupe Speciale Mobile (GSM) microcellular radio pan-european radio vodafone
Land mobile radio Radiotelephony	These twp terms are broader terms (BT) to "cellular radio". If you searched under these terms, you will retrieve a larger set of documents
Radio applications Telecommunication	These terms are top terms (TT) in the hierarchy
Channel allocation Land mobile radio Personal communication networks Radio access networking Space division multiple access	All these terms are related terms (RT) to "cellular radio"
DI January 1985	Date when "cellular radio" was added
mobile radio systems	previous term (PT) used before 1985
B6250F; D4045	class codes

Table 1: Inspec Thesaurus (1999) -- an excerpt on cellular phones

ASFA Thesaurus

P alphabetic go to term next page

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

P-waves [SELECT](#) [WORD BLOCK](#)

Pack ice [SELECT](#) [WORD BLOCK](#)

Packages USE: Containers [SELECT](#) [WORD BLOCK](#)

Packaging fishery products USE: Packing fishery products [SELECT](#) [WORD BLOCK](#)

Packaging materials USE: Packing materials [SELECT](#) [WORD BLOCK](#)

Packing fishery products [SELECT](#) [WORD BLOCK](#)

Packing materials [SELECT](#) [WORD BLOCK](#)

Paddy fields USE: Rice fields [SELECT](#) [WORD BLOCK](#)

ASFA Thesaurus

PACK ICE [SELECT](#)

uf Ice floes

BT [SELECT](#) [Floating ice](#)

rt [SELECT](#) [Ice barriers](#)

rt [SELECT](#) [Ice canopy](#)

rt [SELECT](#) [Ice drift](#)

rt [SELECT](#) [Ice fields](#)

ASFA Thesaurus

PACKING FISHERY PRODUCTS [SELECT](#)

(Referring to methods, techniques and material for packing industrial fishery products)

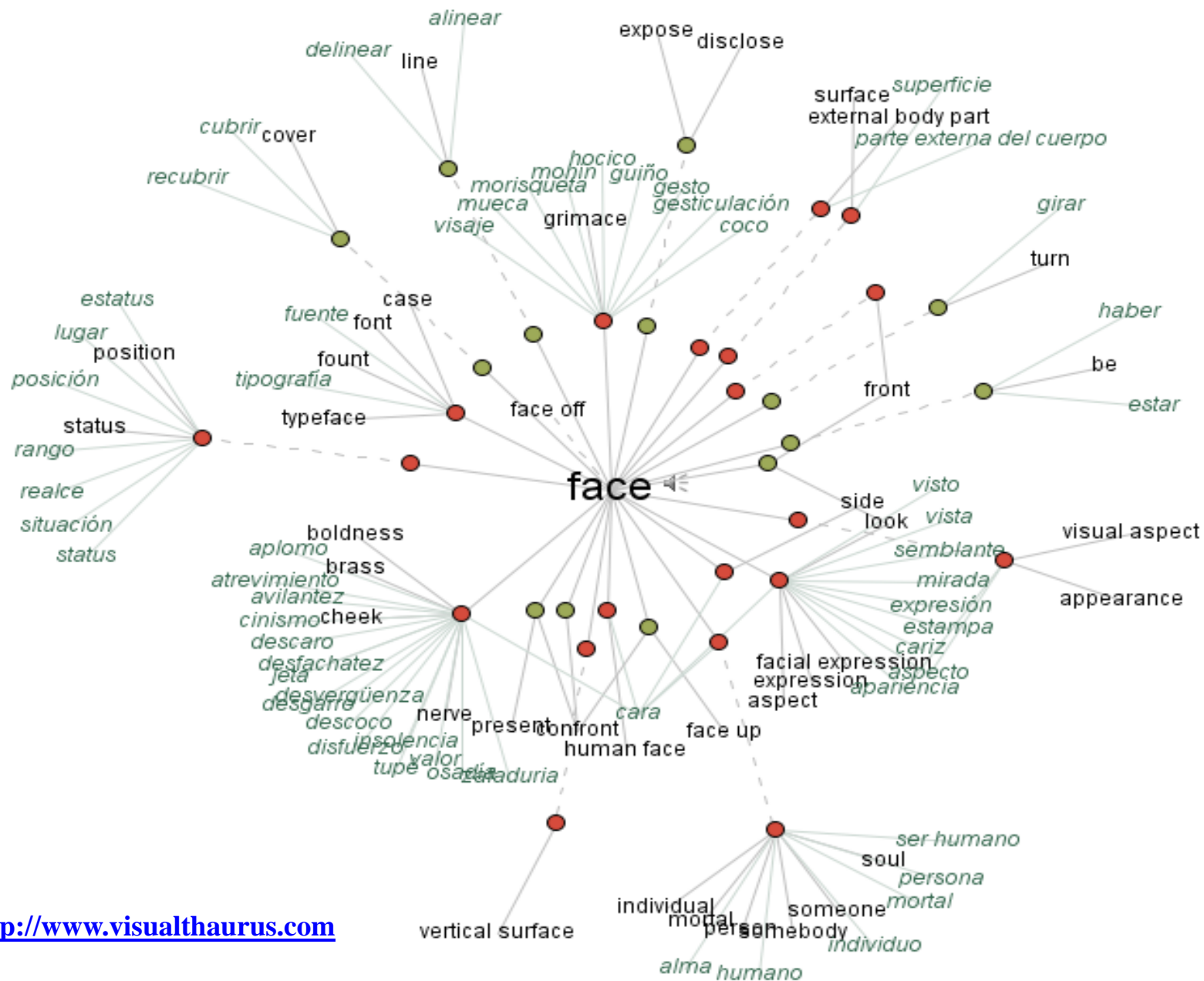
uf Packaging fishery products

rt [SELECT](#) [Fishery industry](#)

rt [SELECT](#) [Fishery products](#)

rt [SELECT](#) [Packing materials](#)

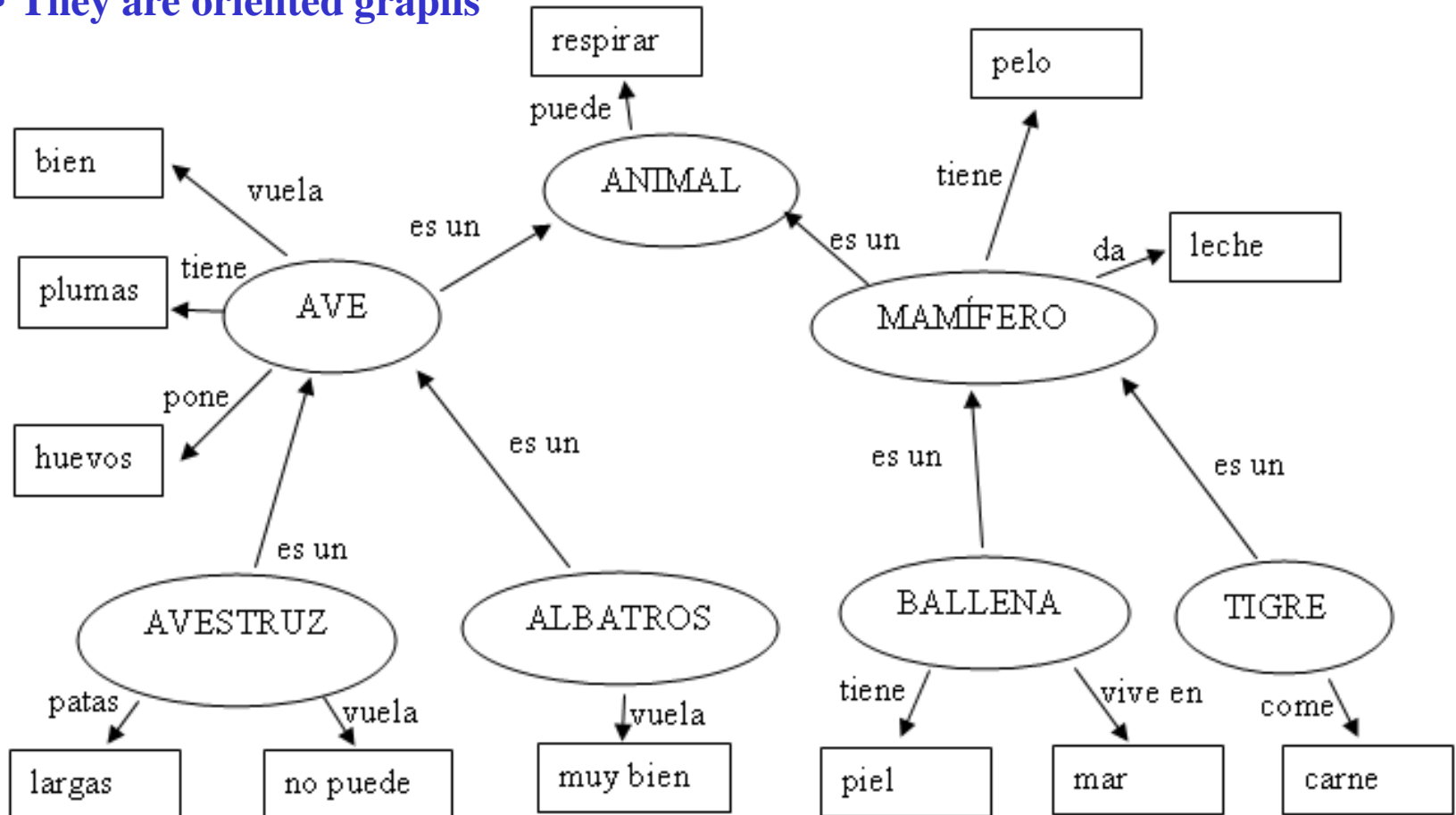
rt [SELECT](#) [Processed fishery products](#)



<http://www.visualthaurus.com>

Semantic network

- Concept structure with nodes and relations, not hierarchically organized
- Can include BT, NT, RT relations or other associative relations
- They are oriented graphs



Lexicons

Generally, of two types

- *general*
 - contain language used in all/general contexts
- *specific*
 - contain the language used in a specific domain of knowledge

Implications of both types of lexicons

- Quantity and quality of information (granularity)
- Complexity of the design
- Complexity in the development process

How are lexicons used in NLP?

- They contain the necessary linguistic information to construct meaning representations

Lexicon

Account *n.* Domain [**financial**]

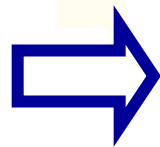
Account *v.* ...

Bank_1 *n* domain [**financial**]

Bank_2 *n* domain [geography]

Money *n.* domain [**financial**]

bank.....
.....account
.....
money.....



Topic=
financial
field

Adapted from Nancy Ide

Lexicon

Went *v* past GO

Go *v.* (NP_SUNJ ((role AGENT) (sem + animate))

(VP ((verb GO)

(PP ((prep TO)

(NP ((role TARGET) (sem +loc))))

John *n.* sem: human

Store *n.* sem: loc

John went to the store



Types of lexicons

- Various types:

- **Morphosyntactic** Information :

- <http://www.mat.upm.es/~aries/description.html>

- <http://www.ims.uni-stuttgart.de/projekte/CorpusWorkbench/CQP-HTMLDemo/PennTreebankTS.html>



- **Semantic** Information:

- Semantic features: human being, animate, human, physical object, mental object
 - Different entries for different senses
 - Semantic relations: synonyms, quasi-synonyms, antonyms, etc.
 - Hierarchical relations: part_of, kind_of, etc...

- **Syntactic-semantic** Information : colocations

- Information about a **domain**

- **Definitions**



PennTreeBank

The screenshot shows a Mozilla Firefox browser window with the title 'The Penn Treebank Tag Set - Mozilla Firefox'. The address bar shows the URL 'http://www.ims.uni-stuttgart.de/projekte/CorpusWorkbench/CQP-HTMLDemo/PennTreebankTS.html'. The browser's menu bar includes 'Archivo', 'Editar', 'Ver', 'Historial', 'Marcadores', 'Herramientas', and 'Ayuda'. The toolbar contains various icons for navigation and search. The main content area displays the title 'The Penn Treebank Tag Set' and a paragraph of text describing the tagset. Below the text is a list of 28 part-of-speech tags with their abbreviations and full names. The browser's status bar at the bottom shows 'Terminado' and a taskbar with various application icons and the system clock.

The Penn Treebank Tag Set

The tagset used in tagging the demo corpus available here is the Penn Treebank Tag set, described for example in *Mitchell P. Marcus, Beatrice Santorini, and Mary Ann Marcinkiewicz: Building a Large Annotated Corpus of English: The Penn Treebank*, in *Computational Linguistics*, Volume 19, Number 2 (June 1993), pp. 313--330 (Special Issue on Using Large Corpora). The tagging was done at UPenn. The following part-of-speech tags are used in the corpus:

1.	CC	Coordinating conjunction
2.	CD	Cardinal number
3.	DT	Determiner
4.	EX	Existential there
5.	FW	Foreign word
6.	IN	Preposition or subordinating conjunction
7.	JJ	Adjective
8.	JJR	Adjective, comparative
9.	JJS	Adjective, superlative
10.	LS	List item marker
11.	MD	Modal
12.	NN	Noun, singular or mass
13.	NNS	Noun, plural
14.	NP	Proper noun, singular
15.	NPS	Proper noun, plural
16.	PDT	Predeterminer
17.	POS	Possessive ending
18.	PP	Personal pronoun
19.	PP\$	Possessive pronoun
20.	RB	Adverb
21.	RBR	Adverb, comparative
22.	RBS	Adverb, superlative
23.	RP	Particle
24.	SYM	Symbol
25.	TO	to
26.	UH	Interjection
27.	VB	Verb, base form
28.	VBD	Verb, past tense

Terminado

Lexicon about “Existence” (Faber and Mairal, 1999)

- 1.1 General: To exist / to continue to exist.
- 1.2 To begin to exist [*be, live*]
 - 1.2.1 To cause something to exist [*create, make*]
- 1.3 To exist in the perception of others [*appear*]
 - 1.3.1 To cause something to exist in the perception of others [*show*]
- 1.4 To exist in time (becoming real) [*happen*]
 - 1.4.1 To cause something to exist in time [*induce, provoke*]
 - 1.4.1.1. To cause something to exist in time in a particular way [*precipitate, hasten*]
 - 1.4.1.2 . To cause something to happen, making it possible [*allow, permit*]
 - 1.4.1.3. To cause something not to happen [*prevent, avoid, stifle, smother*]
- 1.5 To exist as something
 - 1.5.1 To exist as the representation of something else [*represent, express*]
 - 1.5.1.1 To cause something to exist as a representation of something [*copy, reproduce*]
 - 1.5.2 To exist as a part of something [*comprise, constitute*]
- 1.6 To begin to exist [*start, commence, be born*]
 - 1.6.1 To cause to begin to exist [*start, commence*]
 - 1.6.1.1 To cause to be born [*abort*]
 - 1.6.2 To begin to exist in the perception of others [*arise, form*]
 - 1.6.3 To begin to exist in time (becoming real) [*start, originate*]
 - 1.6.3.1 To cause something to begin to exist in time [*start, initiate*]
- 1.7 To continue to exist [*last, endure*]
 - 1.7.1 To stop something from continuing [*interrupt*]
- 1.8 To stop existing [*die*]
 - 1.8.1 To cause somebody/something to stop existing [*kill, murder*]
 - 1.8.2 To stop existing in the perception of others [*disappear, vanish*]
 - 1.8.2.1 To cause something to stop existing in the perception of others [*erase, delete*]
 - 1.8.2.2 To stop existing in time [*end, finish, cease*]
 - 1.8.2.3 To cause something to stop existing in time [*end, finish, cease*]

WordNet 3.0 Vocabulary Helper

[Help for Eva Word Lookup Interfaces](#)

Synonyms/Hypernyms (Ordered by Estimated Frequency) of noun pollution

3 senses of **pollution**

Sense 1

pollution -- (undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities)

- environmental condition -- (the state of the environment)
- impurity, impureness -- (the condition of being impure)

Sense 2

befoulment, defilement, **pollution** -- (the state of being polluted)

- dirtiness, uncleanness -- (the state of being unsanitary)

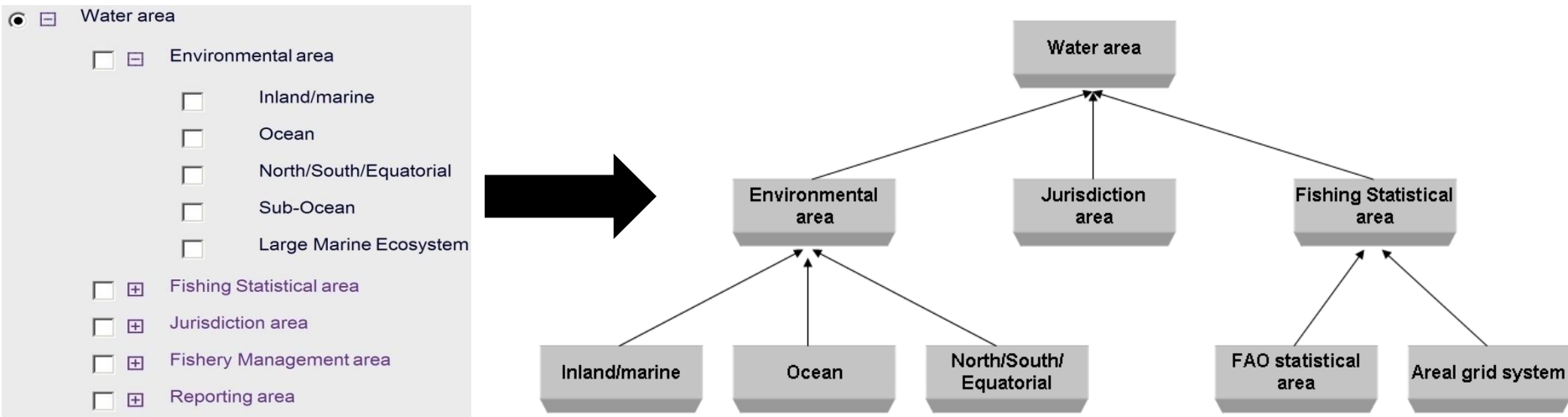
Sense 3

contamination, **pollution** -- (the act of contaminating or polluting; including (either intentionally or accidentally) unwanted substances or factors)

- soiling, soilure, dirtying -- (the act of soiling something)
- 1. (1) **pollution** -- (undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities)
- 2. befoulment, defilement, **pollution** -- (the state of being polluted)
- 3. contamination, **pollution** -- (the act of contaminating or polluting; including (either intentionally or accidentally) unwanted substances or factors)

Classification Scheme

- A classification scheme¹ is the descriptive information for an arrangement or division of objects into groups based on characteristics, which the objects have in common. E.g. water area classification scheme².



1. International Standard Organization (ISO). Information technology - Metadata registries – Part 1: Framework, 2004. Report ISO/IEC FDIS 11179-1.
2. <http://www.fao.org/figis/servlet/RefServlet>

Comparison of lexical resources

CLASSIFICATION CRITERIA	GLOSSARY	DATABASE	DICTIONARY	THESAURUS	LEXICON	ONTOLOGY
Organization	alphabetical order	alphabetical order	alphabetical order	semantically + generically related lexical entries	semantically related lexical entries	semantically related lexical entries
Semantic information	definition in NL	definition + other kinds of info. in NL	definition + pos + etymologies + derivation + usage examples in NL	hierarchical, associative, equivalent relationships	explicit hierarchy (synonymy, antonymy, meronymy...) + grammatical + contextual information	explicitly defined hierarchy relationships around a unique concept
Physical format	paper + electronic format	electronic format	paper + electronic format	paper + electronic format	electronic format	electronic format (readable also by machines)
Domain of knowledge	general + specific	general + specific	general + specific	specific	general + specific	general + specific (agreed by domain experts)

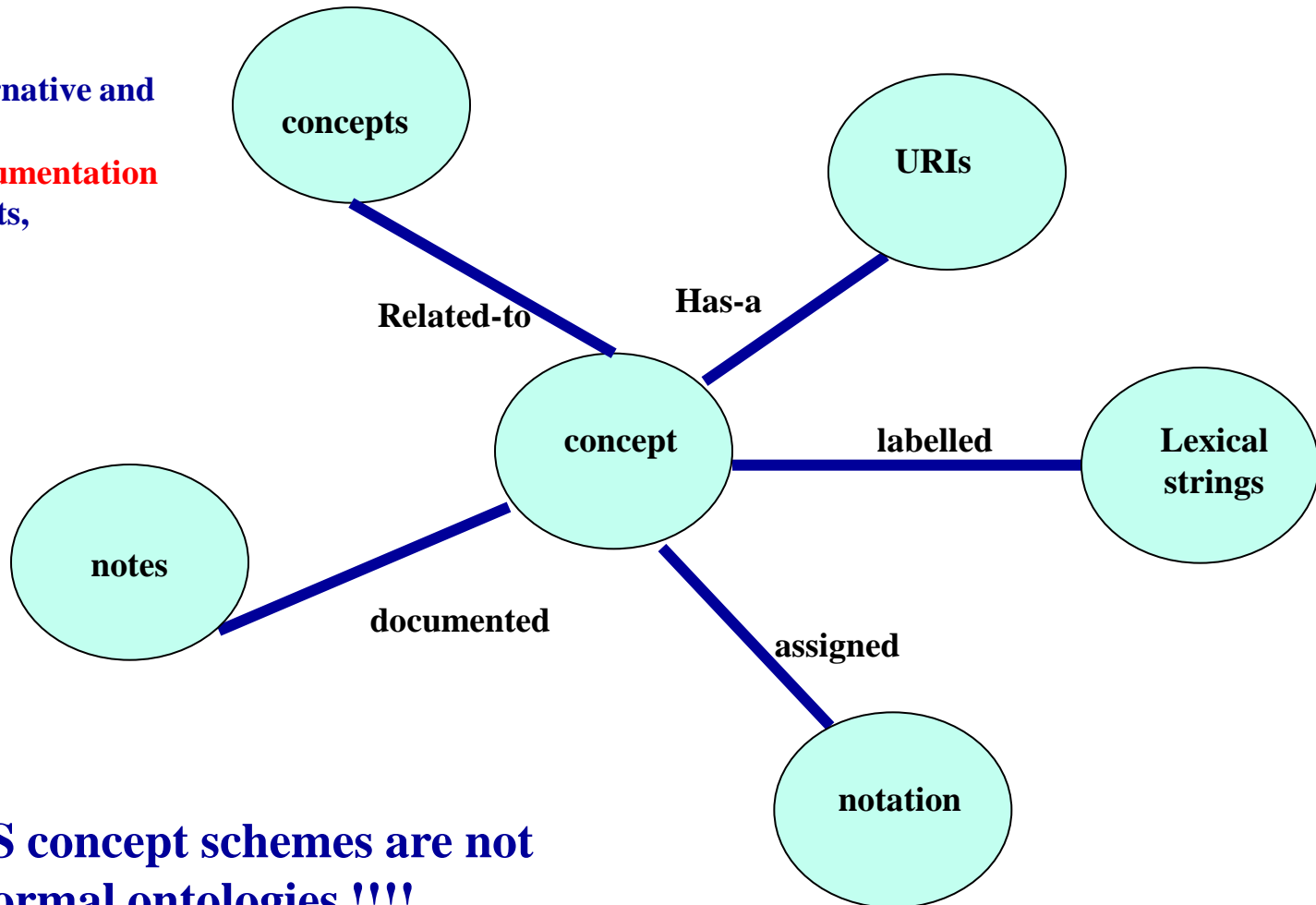
Reusing and sharing KOS in the Semantic Web: SKOS

- Simple Knowledge Organization System
 - Simple, flexible, extensible, machine-understandable representation for sharing KOS
 - **Goal:** to enable easy publication of controlled structured vocabularies for the semantic web
 - Thesauri
 - Classification schemes
 - Subject heading systems
 - Taxonomies
 - Other ‘controlled language’
- **How:** by using a common data model for sharing and linking knowledge organization systems
- **BUT** SKOS is **not** a formal knowledge representation language.

Many exist and are in use in cultural heritage, medicine, libraries, ...

Elements in SKOS

- **Semantic Relationships**
Broader/Narrower Terms
Related Terms
- **Lexical Labels**
Preferred, alternative and hidden labels
- **Additional documentation**
Notes, comments, descriptions

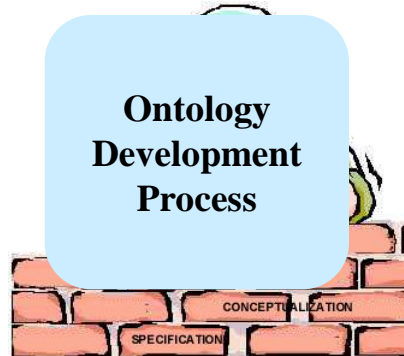
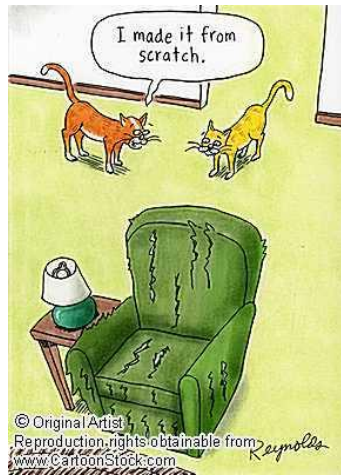


SKOS concept schemes are not formal ontologies !!!!

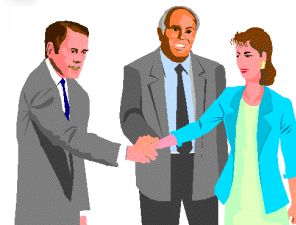
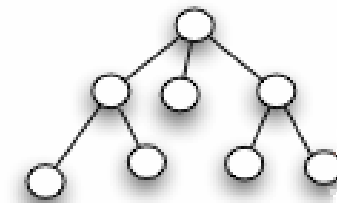
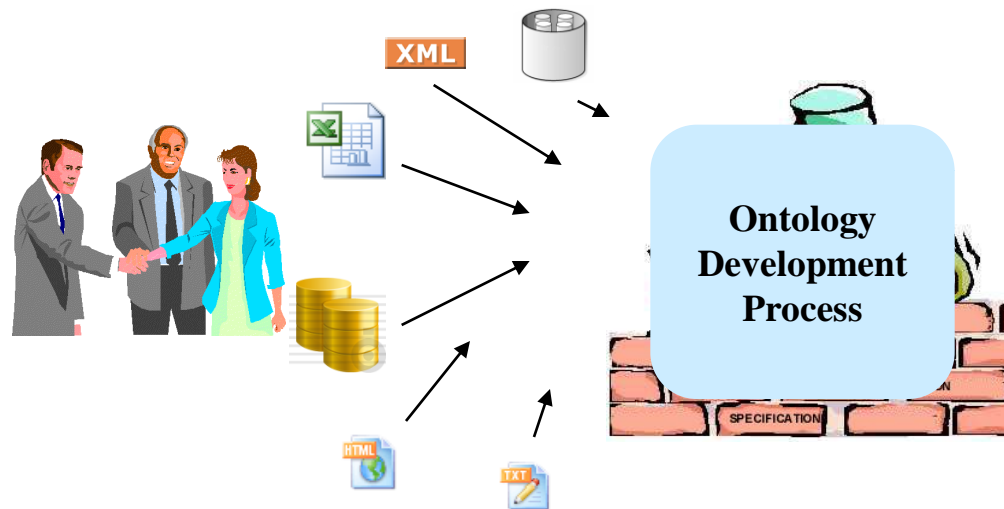
Transforming NOR into ontologies

García-Silva, Gómez-Pérez, Suárez-Figueroa, Villazón-Terrazas

From scratch



Re-engineering available resources



Types of Non-Ontological Resources

Maedche et al. 2001

- *Text*
- *Dictionary*
- *Knowledge base*
- *Relational schemata*

Sabou et al. 2007

- *Unstructured*
- *Semi-structured*
- *Structured*

Gangemi et al. 1998

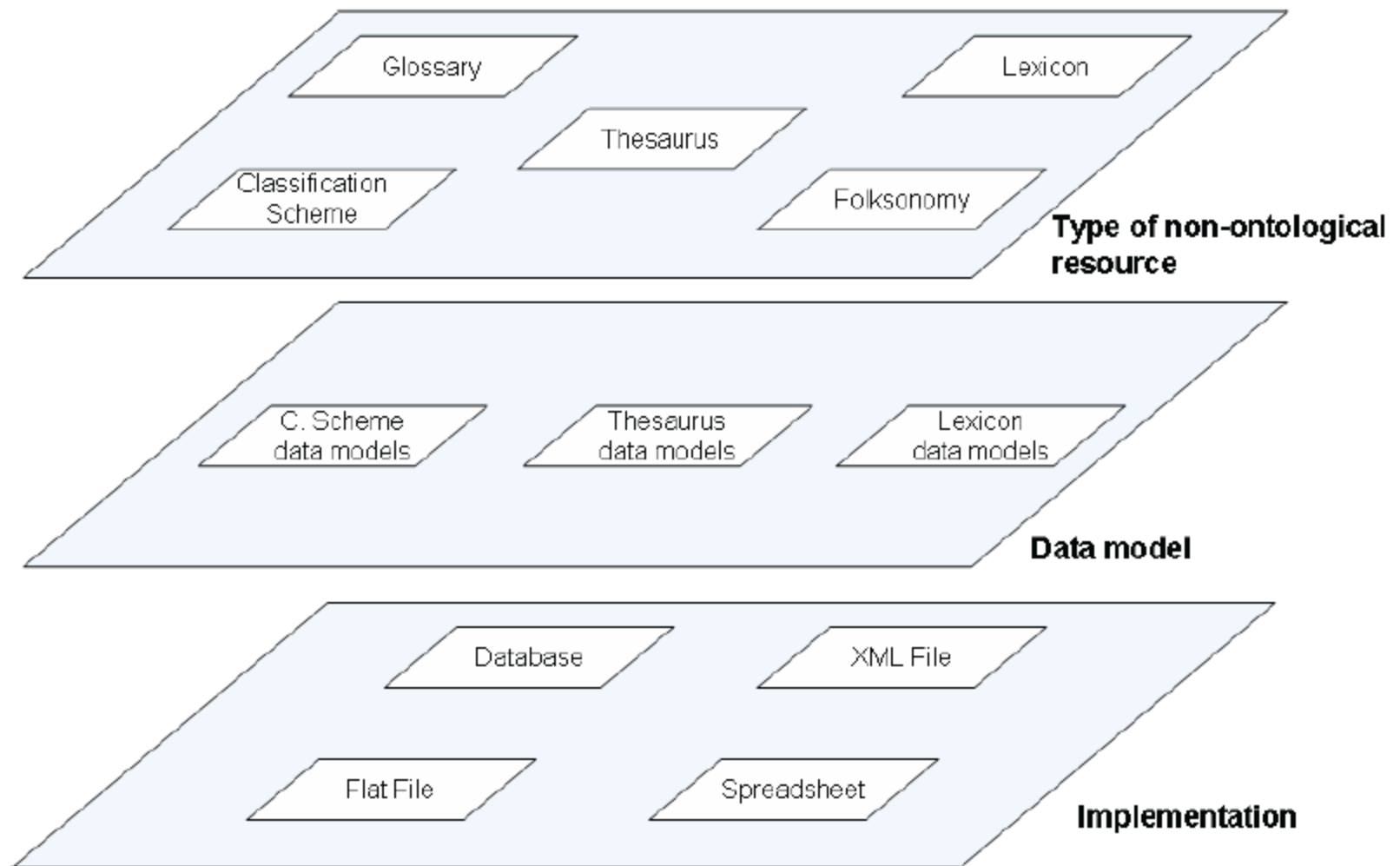
- *Catalogue of normalized terms*
- *Glossed Catalogue*
- *Taxonomy*

Hodge 2000

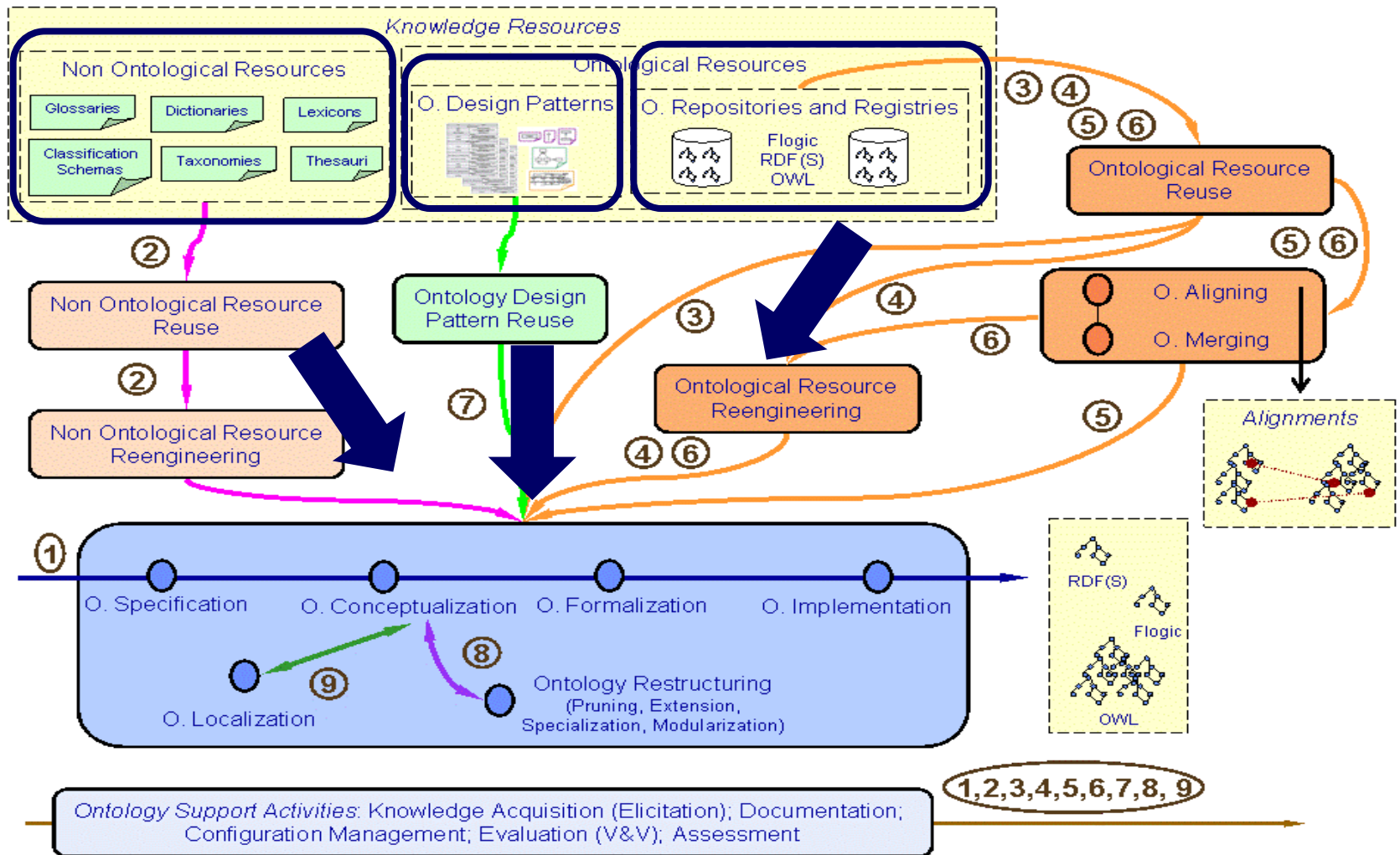
- *Terms Lists*
 - *Authority files*
 - *Glossaries*
 - *Dictionaries*
 - *Gazetteers*
 - *Lexicons*
- *Classification and categories*
 - *Subject headings*
 - *Classification schemes,*
 - *taxonomies and*
 - *categorization schemes*
- *Relationship lists*
 - *Thesauri*
 - *Semantic Newtorks*

They do not take into account the
Non-Ontological Resource
data model, an important artifact
in the re-engineering process.

NOR categorization



The scenario in NeOn



The scenario in NeOn

• **Non-Ontological Resource (NOR)** is an existing knowledge resource whose semantics has not yet been formalized by means of an ontology.

• **Non-Ontological Resource Re-engineering** refers to the process of taking an existing non-ontological resource and transforming it into an ontology.



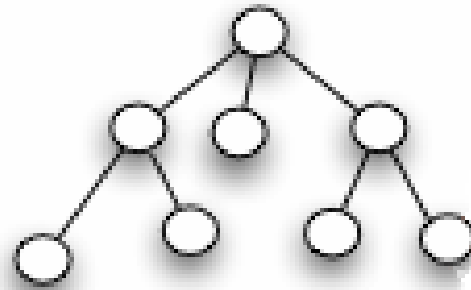
Motivation

resource



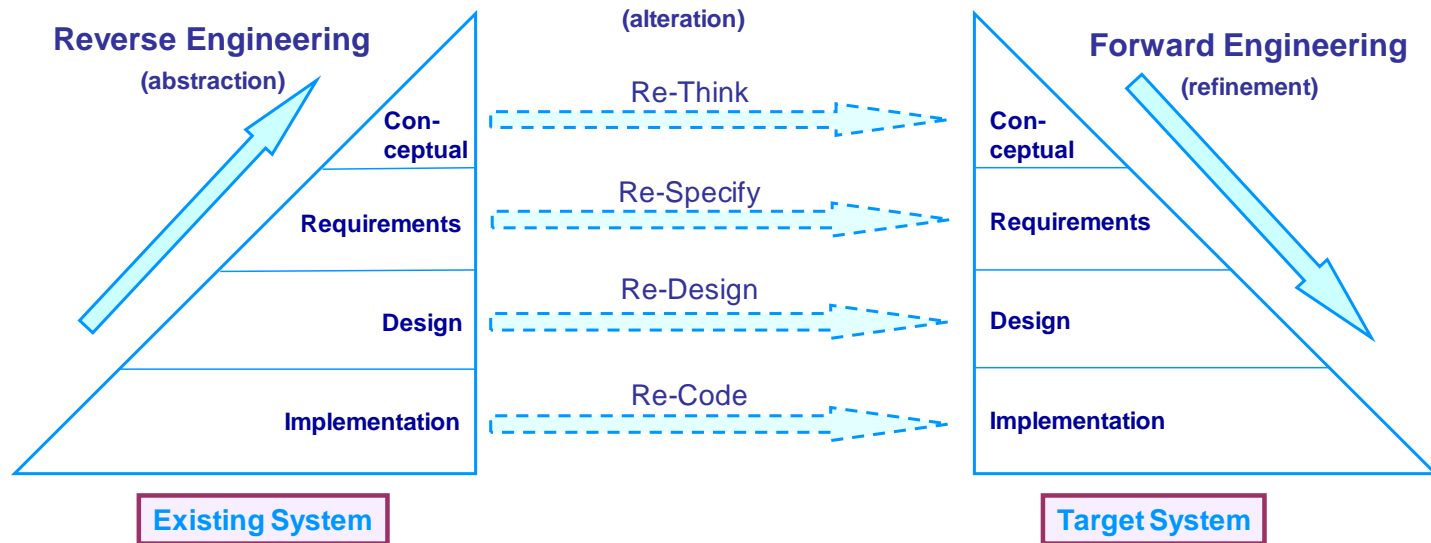
How?

I want to transform my non-ontological resource into an ontology



ontology

Software Re-engineering



General Model for Software Reengineering

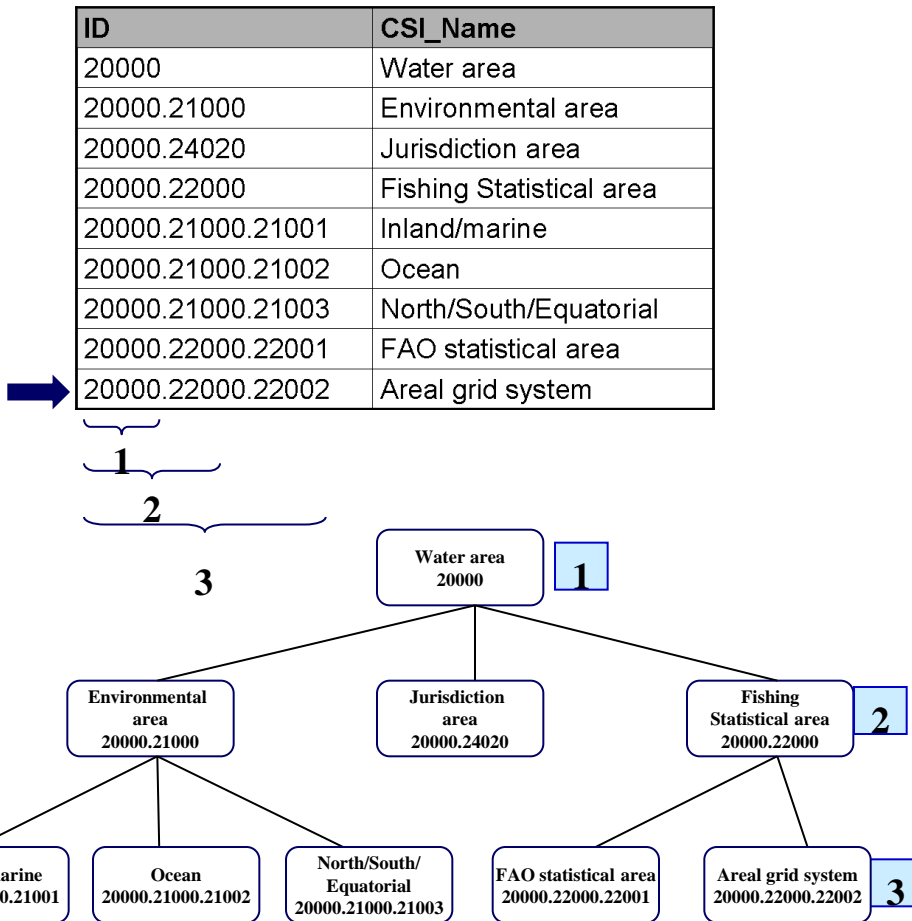
- 1) The conceptual level describes in general terms the functional characteristics of the system;
- 2) The requirement level is the specification of the problem being solved;
- 3) The design level is the specification of the solution; and
- 4) The implementation level refers to the coding, testing and delivery of the operational system



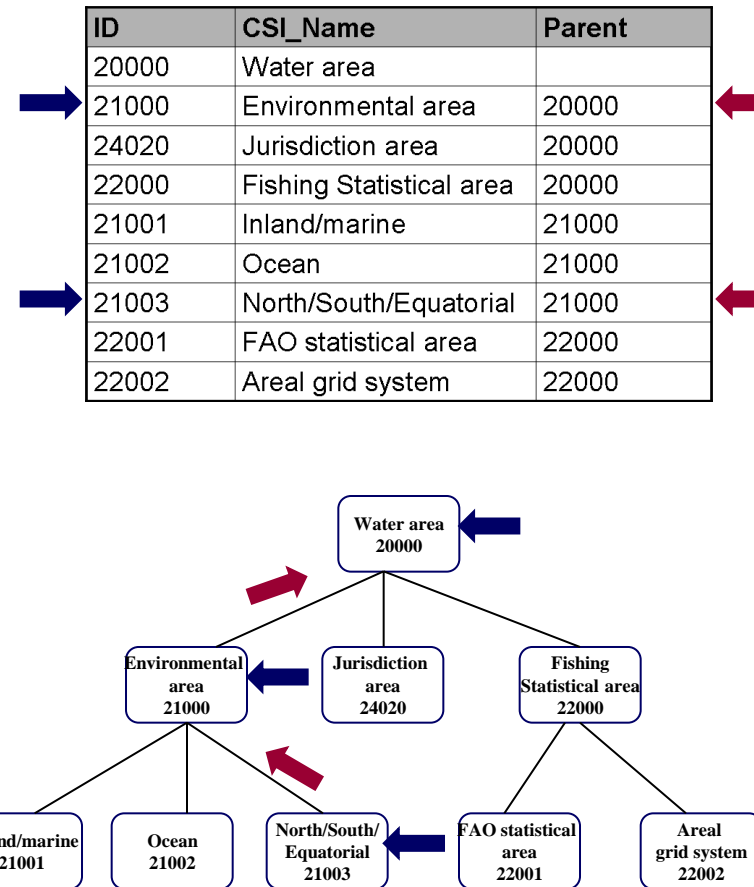
E.J. Byrne. A conceptual foundation for software re-engineering.
In Proceedings of the International Conference on Software Maintenance and Reengineering, pages 226–235.
IEEE Computer Society, 1992.

Data Models (I)

- Path Enumeration Data Model** is defined as a model that, for each node, it stores the path (as a string) from the root to the node.

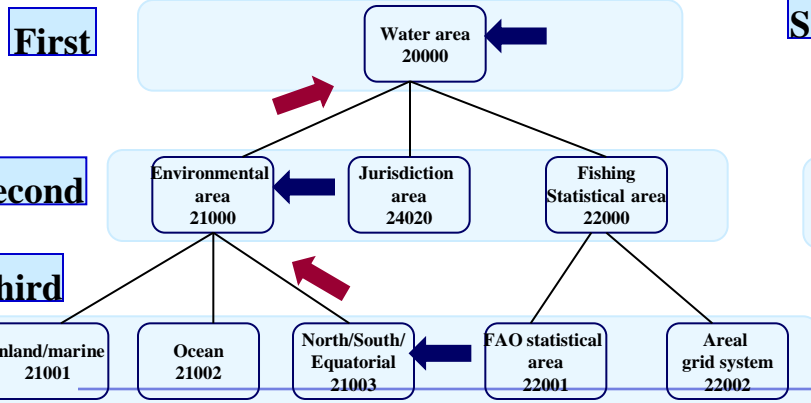
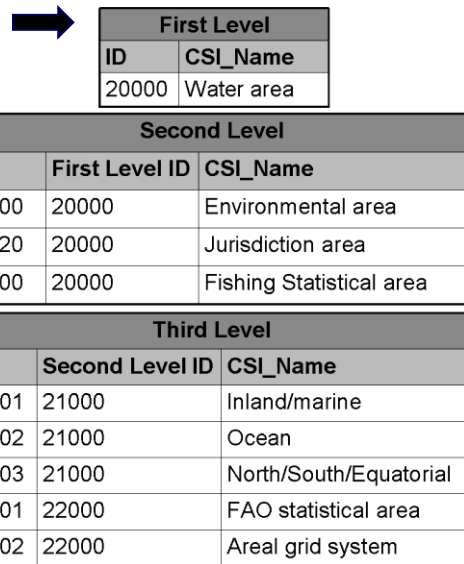


- Adjacency List** is a recursive structure for hierarchical representations that comprises a list of nodes with a linking column to their parent nodes.

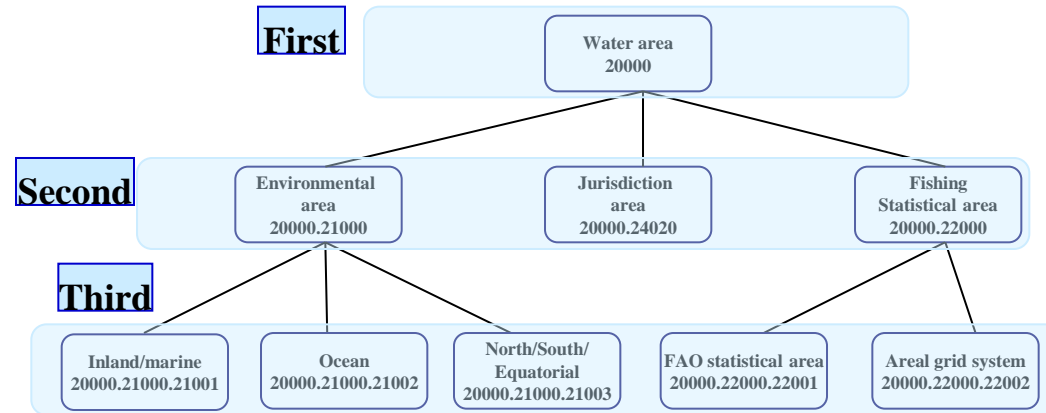
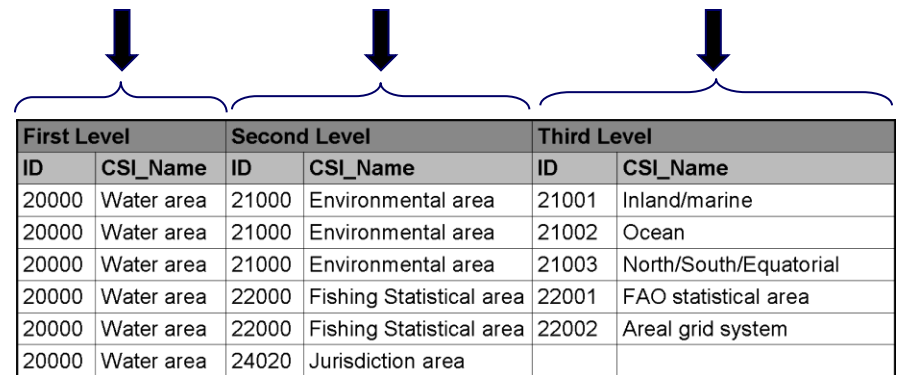


Data Models (II)

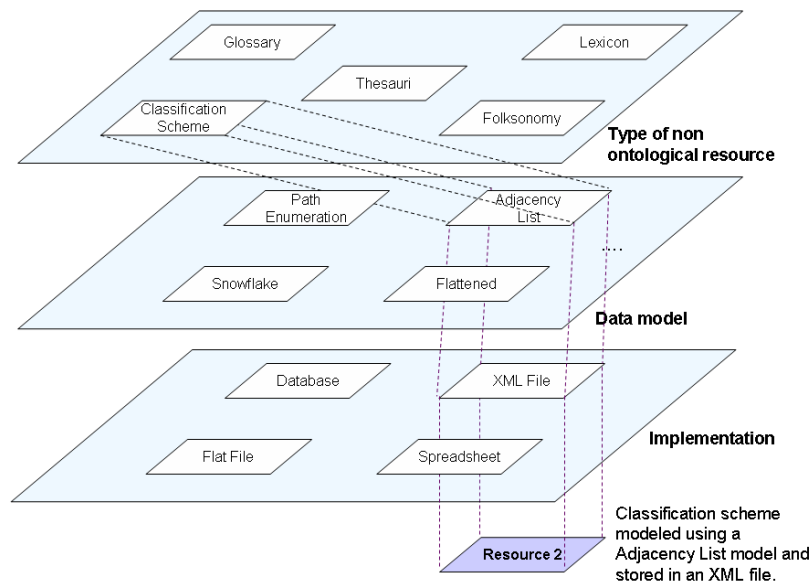
- Snowflake Data Model** is a normalized structure for hierarchical representations. For each hierarchical level an entity is created. In this model each hierarchy node has a column linked to its parent node.



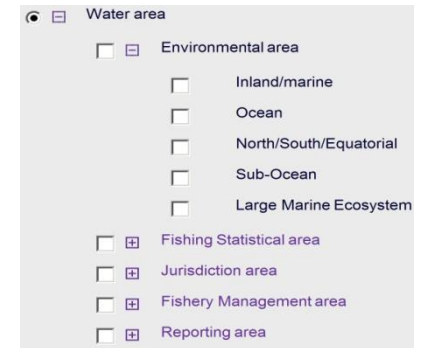
- Flattened Data Model**, is a de-normalized structure. The hierarchy is represented with a table where each hierarchical level is stored in a different column.



Example - FAO Water Areas Classification Scheme



Classification Scheme



Adjacency List

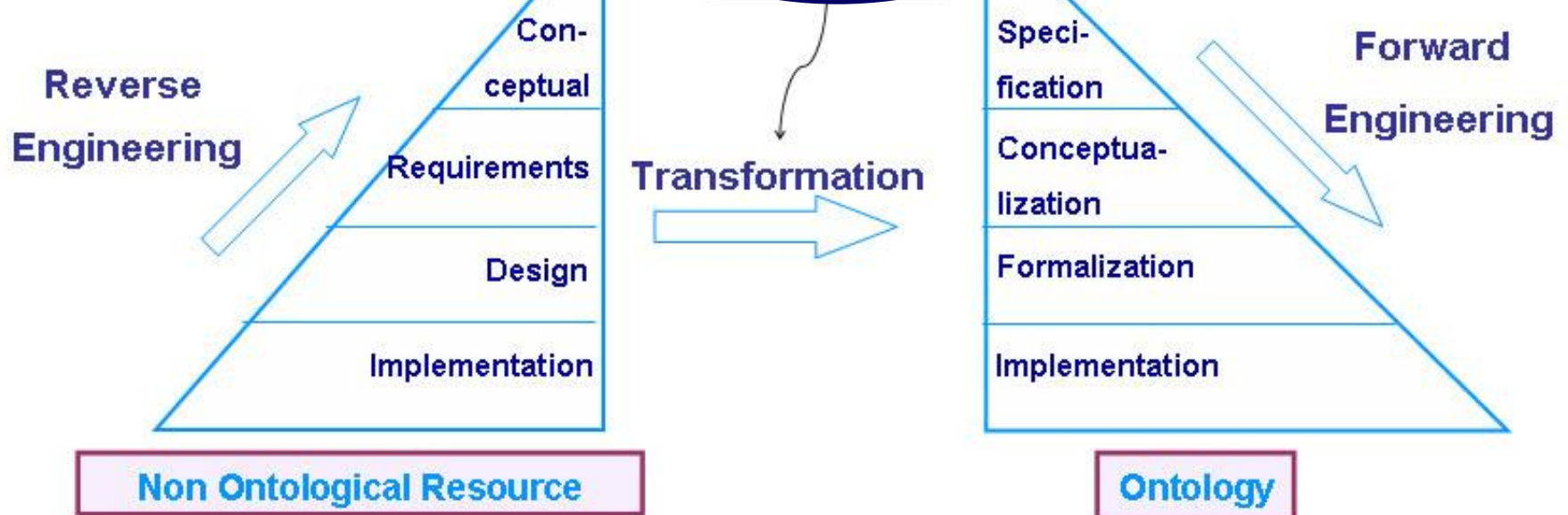
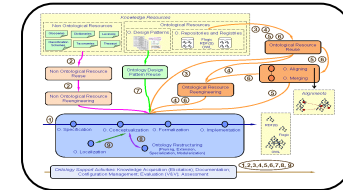
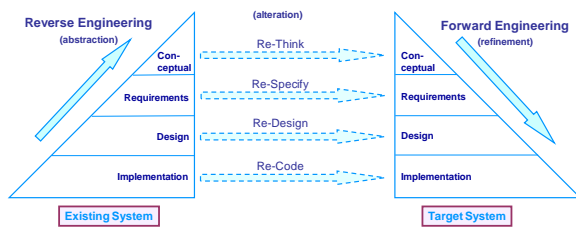
ID	CSI_Name	Parent
20000	Water area	
21000	Environmental area	20000
24020	Jurisdiction area	20000
22000	Fishing Statistical area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
22001	FAO statistical area	22000
22002	Areal grid system	22000

XML

```
<Classification>
  <Category>
    <NodeId>20000</NodeId>
    <WaterCategory>Water Area</WaterCategory>
    <parentNodeId>1</parentNodeId>
  </Category>
  <Category>
    <NodeId>21000</NodeId>
    <WaterCategory>Environmental area</WaterCategory>
    <parentNodeId>20000</parentNodeId>
  </Category>
  <Category>
    <NodeId>22000</NodeId>
    <WaterCategory>Fishing statistical area</WaterCategory>
    <parentNodeId>20000</parentNodeId>
  </Category>
  <Category>
    <NodeId>24020</NodeId>
    <WaterCategory>Jurisdiction area</WaterCategory>
    <parentNodeId>20000</parentNodeId>
  </Category>
  <Category>
    <NodeId>21001</NodeId>
    <WaterCategory>inland/marine</WaterCategory>
    <parentNodeId>21000</parentNodeId>
  </Category>
  ...
</Classification>
```




NeOn Approach for Re-engineering NORs



<http://ontologydesignpatterns.org/>

PR-NOR Template

Slot	Value
General Information	
Name	Name of the component
Identifier	An acronym composed of: component type + abbreviated name of the component + number
Component Type	Pattern for Re-engineering Non-Ontological Resource (PR-NOR)
Use Case	
General	Description in natural language of the re-engineering problem addressed by the pattern for re-engineering non-ontological resources.
Example	Description in natural language of an example of the re-engineering problem.
Pattern for Re-engineering Non-Ontological Resource.	
Resource to be Re-engineered	
General	Description in natural language of the non-ontological resource.
Example	Description in natural language of an example of the non-ontological resource.
Graphical Representation	
General	Graphical representation of the non-ontological resource
Example	Graphical representation of the example of non-ontological resource.
Designed Ontology	
General	Description in natural language of the ontology created after applying the pattern for re-engineering the non-ontological resource.
Graphical Representation	
(UML)General Solution Ontology	Graphical representation, using the UML profile [BHO6] , of the ontology created for the non-ontological resource being re-engineered.
(UML)Example Solution Ontology	Example showing a graphical representation, using the UML profile [BHO6] , of the ontology created for the non-ontological resource being used.
How to Re-engineer	
General	Description in natural language of the general re-engineering process, using a sequence of activities.
Example	Description in natural language of the re-engineering process applied to the non-ontological resource example, using the above sequence of activities.
Implementation (Optional)	Link to a website which holds the code for an implementation, in a particular programming language, of the re-engineering process.
Relationships (Optional)	
Relations to other modelling components	Description of any relation to other PR-NOR patterns or other design patterns.

INPUT: Non-Ontological Resource

OUTPUT: Ontology

PROCESS: How

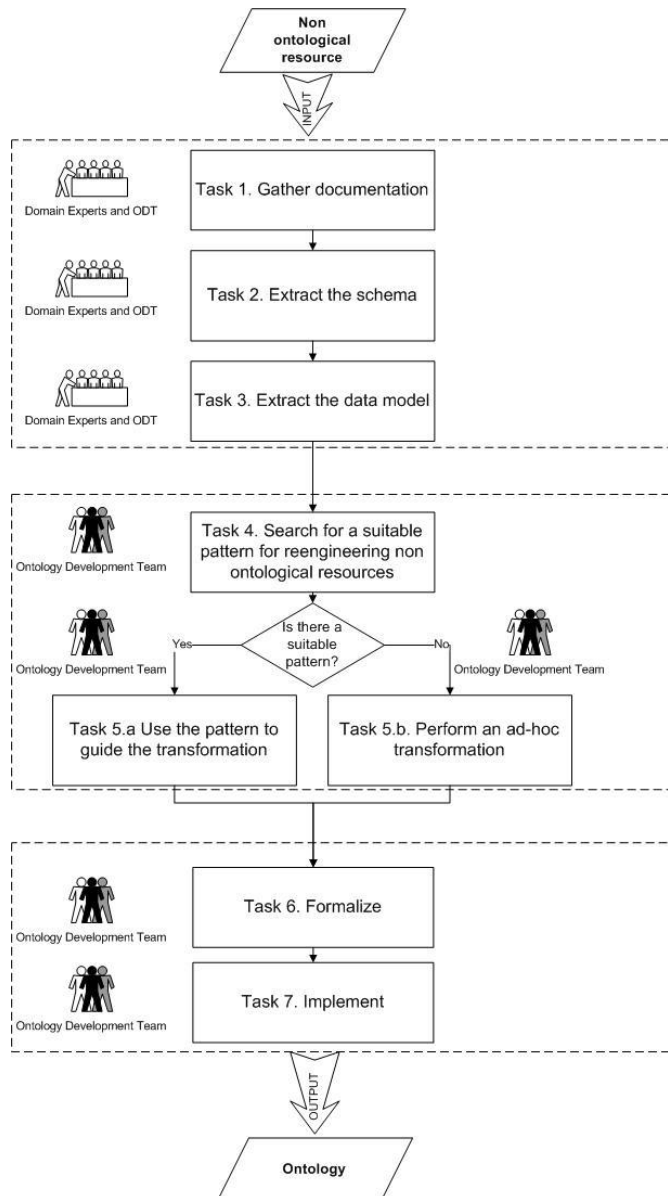
PR-NOR Template

INPUT: Resource to be Re-engineered	
General	Description in natural language of the non-ontological resource.
Example	Description in natural language of an example of the non-ontological resource.
Graphical Representation	
General	Graphical representation of the non-ontological resource.
Example	Graphical representation of the example of non-ontological resource.

OUTPUT: Designed Ontology	
General	Description in natural language of the ontology created after applying the pattern for re-engineering the non-ontological resource.
Graphical Representation	
(UML) General Solution Ontology	Graphical representation, using the UML profile [BH06], of the ontology created for the non-ontological resource being re-engineered.
(UML) Example Solution Ontology	Example showing a graphical representation, using the UML profile [BH06], of the ontology created for the non-ontological resource being used.

PROCESS: How to Re-engineer	
General	Description in natural language of the general re-engineering process, using a sequence of activities.
Example	Description in natural language of the re-engineering process applied to the non-ontological resource example, using the above sequence of activities.

Non-Ontological Resource Re-engineering Process (I)



Activity 1
Non-Ontological Resource
Reverse Engineering

Activity 2
Non-Ontological Resource
Transformation

Activity 3
Ontology
Forward Engineering

Terminology and ontologies

- Terminology helps in the knowledge organization by establishing relations between terms and concepts
- An ontology is a conceptualization or representation of a domain, agreed by experts and readable by a machine
- Approach oriented to the communication among users of an organization
- Terminological change: from terminological data bases to terminological and knowledge/ontological data bases: terms in context and with relations among them
- Terms retrieved from texts can be the starting point in the development of ontologies

Comparison factors

	Terminology	Ontologies
Level of formality in the definition	Text in NL	Formal language without ambiguities
Computer support	Terminological bases with few relations among concepts	Sound knowledge representation languages with relations among concepts
Users	Translators Domain experts Linguistic mediators Text editors	Information interchange between people and machines
Language	NL for expressing knowledge with precision	Labels for naming concepts have less importance

Terminology in ontologies and other lexicographic resources

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