Ontologies and Terminology

Asunción Gómez-Pérez (asun@fi.upm.es)

Credits to:
Guadalupe Aguado (lupe@fi.upm.es)
Boris Villazón-Terrazas (bvillazon@fi.upm.es)
Mari Carmen Suárez -Figueroa (mcsuarez@fi.upm.es)
Guadalupe Aguado (lupe@fi.upm.es**)**

Work distributed under the license Creative Commons Attribution-Noncommercial-Share Alike 3.0

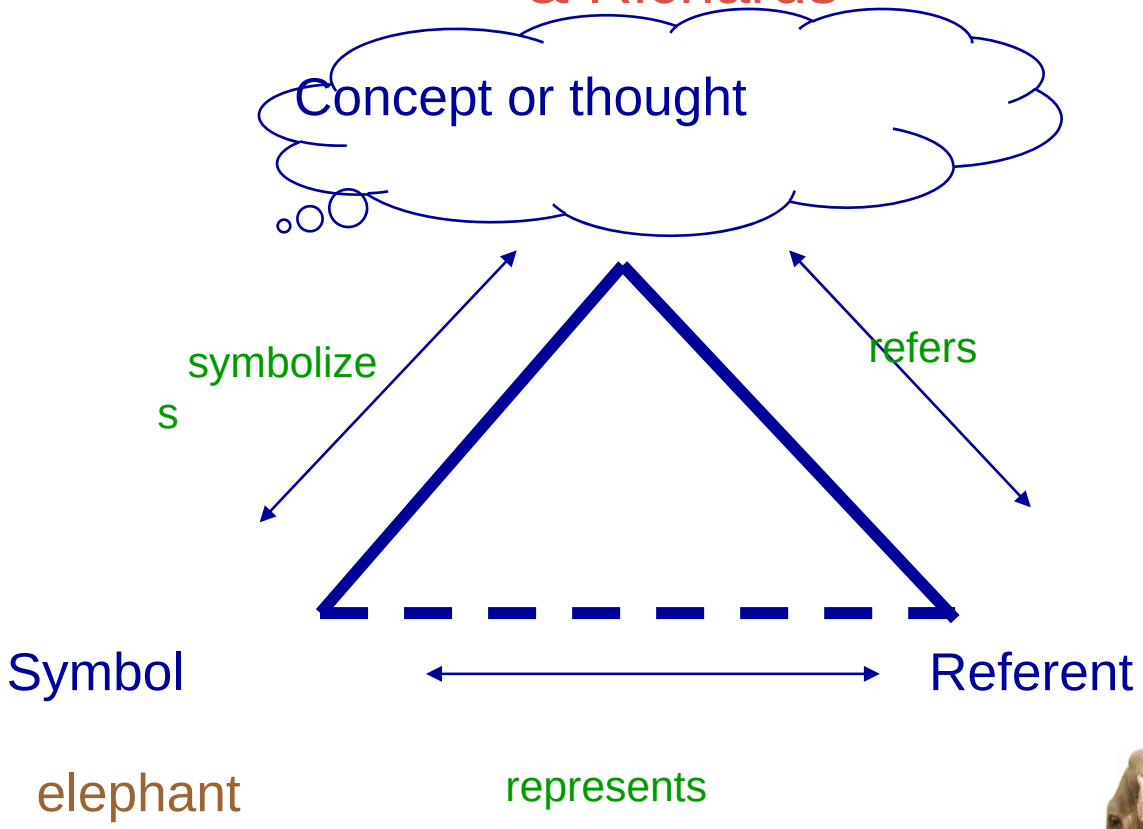
 © A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Index

- Terminology and ontologies
- Motivation
- Types of non ontological resources
- From Knowledge resources to Ontologies
- Example
- Conclusion

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Semantic triangle by Ogden & Richards



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

The object of study of terminology

- 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

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

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 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)
  - The extension of the concept planet includes: *Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.*

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

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, metalic, …
    - **Colour**: red, blue, green, orange…
    - **Position:** vertical, hanging, slanting
  - **extrinsic,** relation of the object with others
    - **Mode of employement** or application: *analogic, digital, hybrid.*
    - **Origin** or how an object comes into existence: producer, inventor, provider, the place of its production, (town, country), …

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Characteristics of a concept

- **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.*

- 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.

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Relations between concepts: hierarchical relations

Close relation between a concept and its characteristics

A. GENERIC RELATIONS (genus-species relation) IS_A

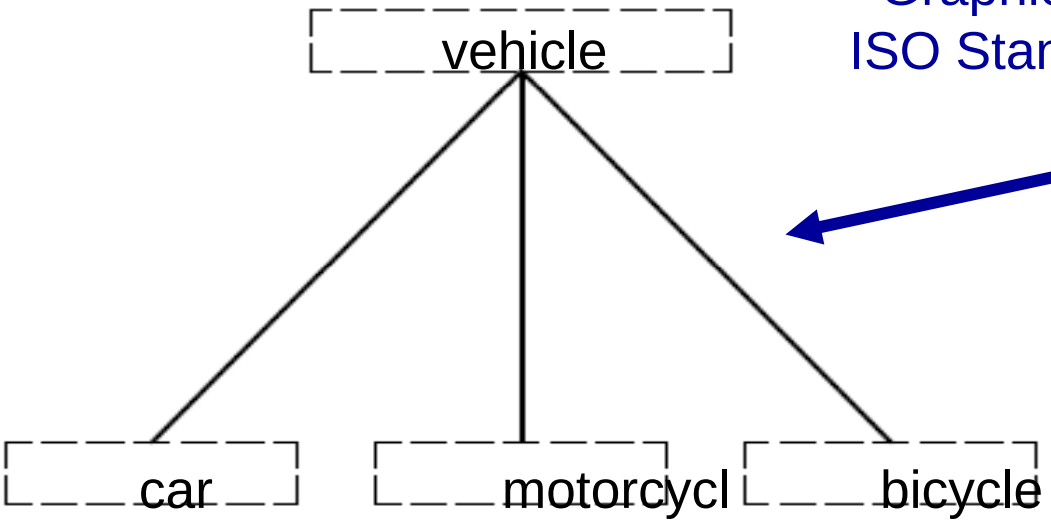
- One of the concepts includes another concept
  - **vertical:** hypernym- hyponym; superordinate –subordinate
  - **horizontal:** two specific ideas of the same generic concept with some distinguishing characteristics
- In thesaurus
  - *Broader than* (BT)
  - *Narrower than* (NT)
  - *Associated to*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

B. PARTITIVE RELATIONS (part-whole relation) PART_OF

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

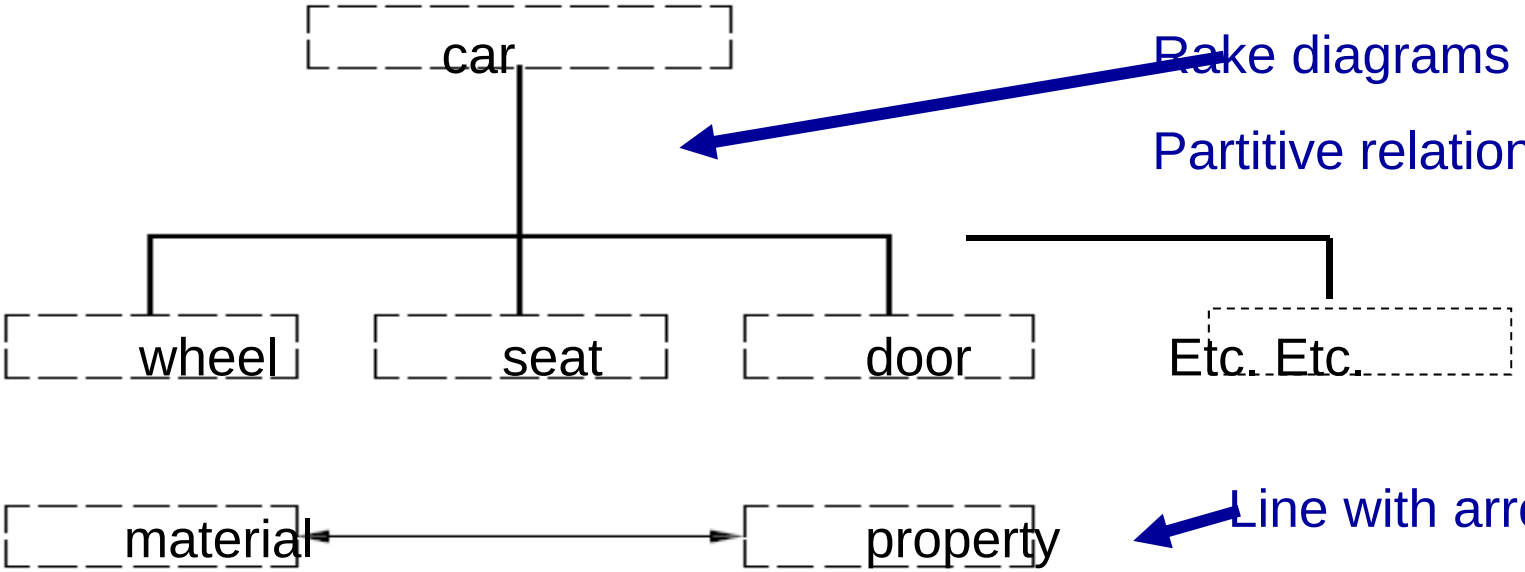
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Graphic representations used in ISO Standards



Tree diagram

Generic concept relations



Rake diagrams

Partitive relations

Line with arrowheads

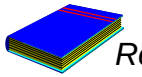
Associative relations

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Other Meronimic Relations

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

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



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

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

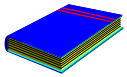
Non-hierarchical relations (associative relations)

- ***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**)

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

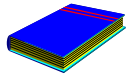
Definitions of Ontologies (I)

1. "An ontology defines the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations to define extensions to the vocabulary"



Neches, R.; Fikes, R.; Finin, T.; Gruber, T.; Patil, R.; Senator, T.; Swartout, W.R. *Enabling Technology for Knowledge Sharing*. AI Magazine. Winter 1991. 36-56.

2. "An ontology is an explicit specification of a conceptualization"

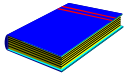


Gruber, T. *A translation Approach to portable ontology specifications.* Knowledge Acquisition. Vol. 5. 1993. 199-220.

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

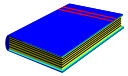
Definitions of Ontologies (II)

3. An ontology is a hierarchically structured set of terms for describing a domain that can be used as a skeletal foundation for a knowledge base.



B. Swartout; R. Patil; k. Knight; T. Russ. *Toward Distributed Use of Large-Scale Ontologies* Ontological Engineering. AAAI-97 Spring Symposium Series. 1997. 138-148.

4. An ontology provides the means for describing explicitly the conceptualization behind the knowledge represented in a knowledge base.



A. Bernaras;I. Laresgoiti; J. Correra. *Building and Reusing Ontologies for Electrical Network Applications* ECAI96. 12th European conference on Artificial Intelligence. Ed. John Wiley & Sons, Ltd. 298-302.

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Definitions of Ontologies (III)

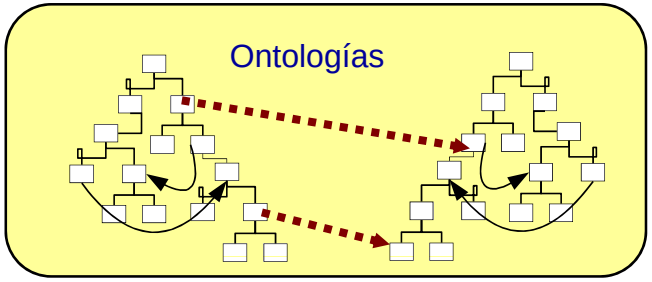
5. "An ontology is a formal, explicit specification of a shared conceptualization'

Machine-readable

Concepts, properties relations, functions, constraints, axioms, are explicitly defined

Consensual Knowledge

Abstract model and simplified view of some phenomenon in the world that we want to represent



Studer, Benjamins, Fensel. Knowledge Engineering: Principles and Methods. *Data and Knowledge Engineering*. 25 (1998) 161-197

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Definitions of Ontologies (IV)

Lightweight Ontologies :

- Include Concepts with properties and Taxonomies
- Do not include Axioms and constraints.

Heavyweight Ontologies :

- Include all the components
- Excellent!! If they have a lot of axioms.

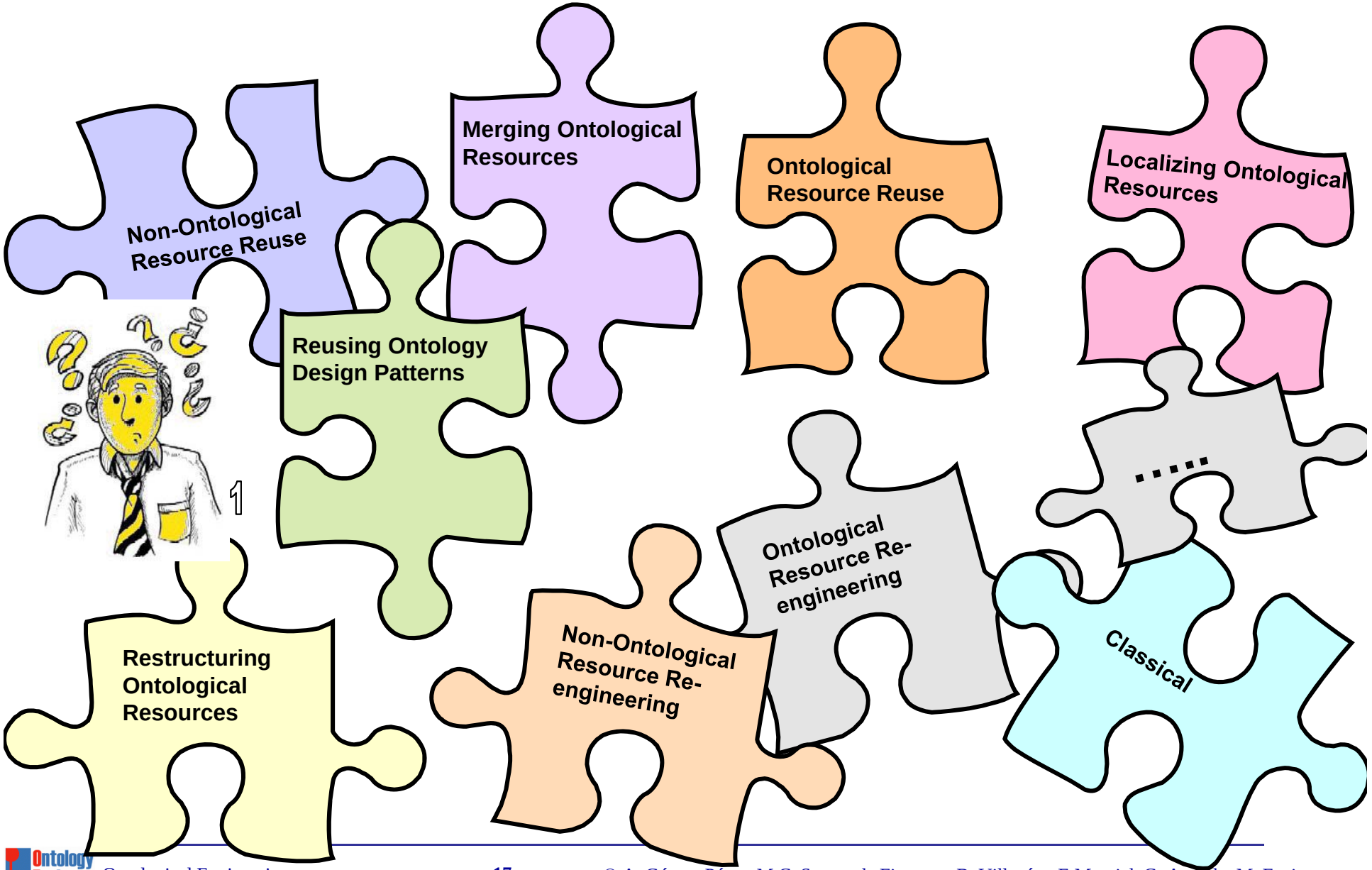
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Index

- Terminology and ontologies
- Motivation
- Types of non ontological resources
- From Knowledge resources to Ontologies
- Example
- Conclusion

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Motivation



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Motivation

In our team, we want to build an OWL ontology in the pharmaceutical domain, but we want to use several pharmaceutical standards in XML and classification schemes in our own format.

Classical

Non Ontological Resource Reuse

Non Ontological Resource Reengineering

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Motivation

In our team, we want to build an ontology
human resources management domain.
ontology should include information ab
occupations and activity sectors, data must be k
in the original DBs, and we want to have
tology in seve atural languages.

Classical

Ontology

Mappings

Ontology-DB mapping

Ontological Resource Reuse

Re-engineering Non-ontological resources

Localizing Ontological Resources

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Monti, G. Ag o, M.

Building ontologies in the 1990s and 2000s

Methodologies for building single ontologies do not consider the reuse of knowledge

- Uschold and King's method
- Grüninger and Fox's methodology
- KACTUS approach
- METHONTOLOGY
- SENSUS method
- On-To-Knowledge
- DILIGENT

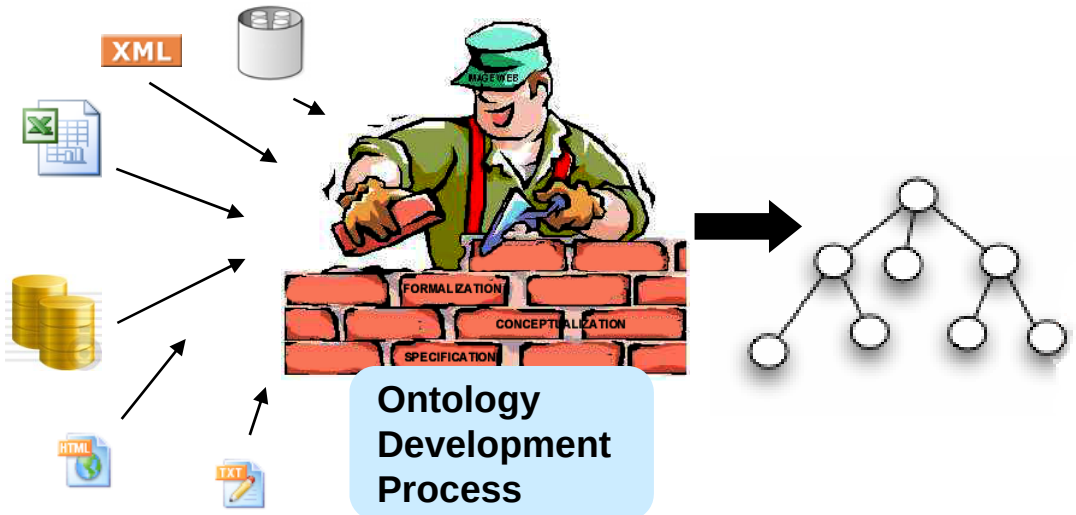
Ontology learning approaches for building ontologies from structured, semi-structured and non-structured data

- Are not integrated with current methodologies
- Mainly from non-structured data using NLP techniques

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

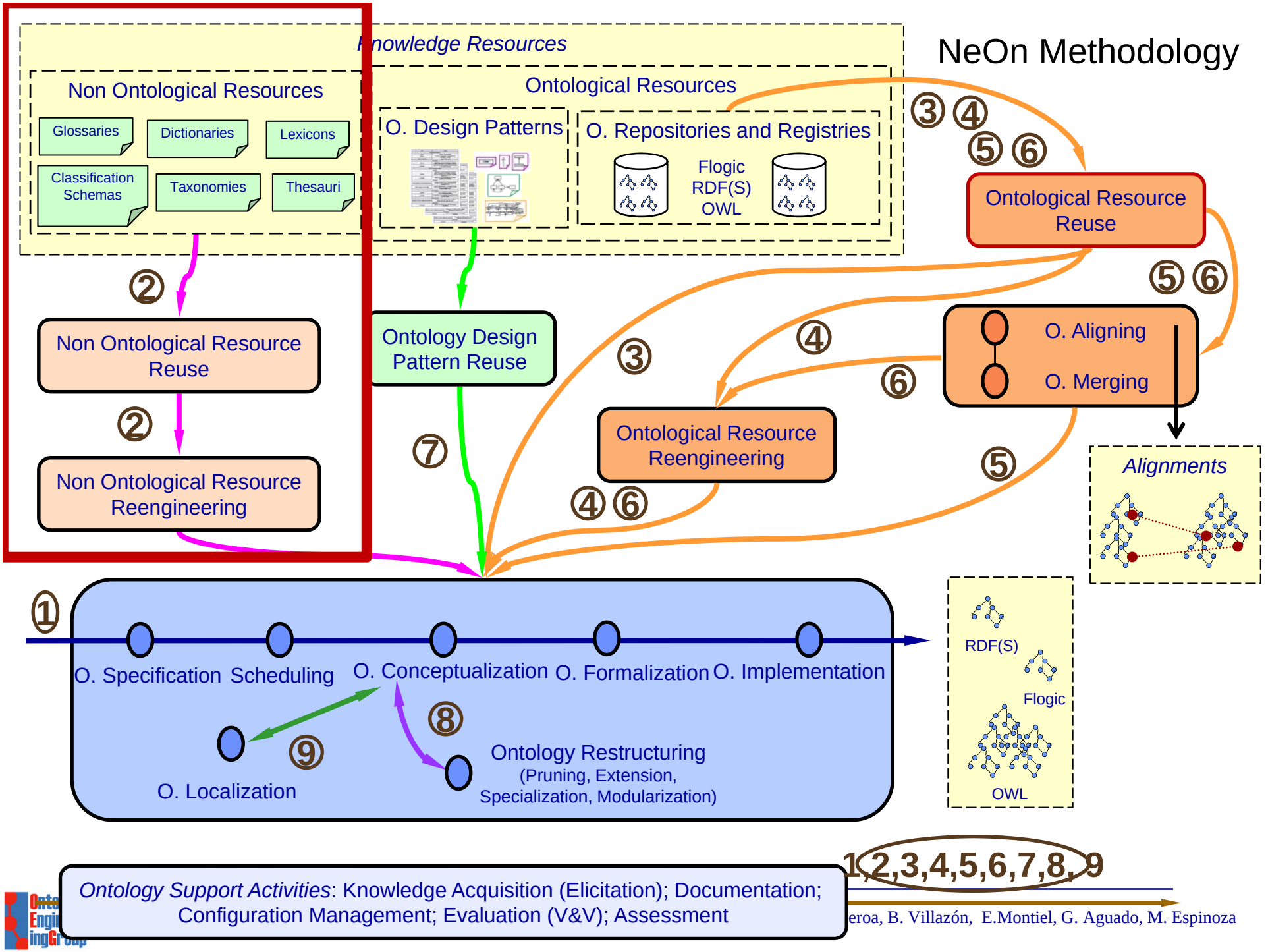
Current situation in 2010

- Reuse of knowledge-aware resources
- Ontologies are built collaboratively
- Ontologies are connected in ontology networks



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

NeOn Methodology



Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

Index

- Terminology and ontologies
- Motivation
- Types of non ontological resources
- From Knowledge resources to Ontologies
- Example
- Conclusion

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Lexicon

- A lexicon is a list of words in a language (a vocabulary) along with some knowledge of how to use each word.
  - General or domain-specific;
  - Monolingual (Wordnet) or multilingual (Eurowordnet)

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Noun

- {09411430} S: (n) **river** (a large natural stream of water (larger than a creek)) *"the river was navigable for 50 miles"*
  - ***part meronym***
    - {09274500} S: (n) estuary (the wide part of a river where it nears the sea; fresh and salt water mix)
    - {09405396} S: (n) rapid (a part of a river where the current is very fast)
    - {09475292} S: (n) waterfall, falls (a steep descent of the water of a river)
  - *domain term category*
  - *has instance*
  - *direct hypernym* / *inherited hypernym* / *sister term*
    - {09448361} S: (n) stream, watercourse (a natural body of running water flowing on or under the earth)
  - *part holonym*
    - {09476011} S: (n) water system (a river and all of its tributaries)

WordNet home page

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Lexicon data models

- Record-based data model

Word	Gloss	POS	Part Meronym	Part Holonym	Hypernym	Hyponym	...
river	a large natural stream of water (larger than a creek); "the river was navigable for 50 miles"	N	estuary rapid waterfall	water system	stream		
	...						

- Relation-based data model

Synsetid	Word	POS	Gloss	...
108614198	river	n	a large natural stream of water (larger than a creek); "the river was navigable for 50 miles"	...
108814882	rapid	n	a part of a river where the current is very fast	...
108696219	stuary	n	the wide part of a river where it nears the sea; fresh and salt water mix	...
108854154	stream	n	a natural body of running water flowing on or under the earth	...
...	...	...	...	...

Synset1id	Synset2id	Linkid
108614198	108696219	11
108614198	108854154	1
...	...	...

Linkid	Link
1	hypernym
11	part holonym
12	part meronym
...	...

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

WordNet 3.0 Vocabulary Helper

pollution Search

Help for Fwn 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)

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Thesauri

- Controlled vocabularies of terms in a particular domain
- Relations: hierarchical, associative and equivalence relations between terms.
- Thesauri are mainly used for indexing and retrieving of articles in large databases.

EN : Oryza	BT (subclassOf) : Poaceae
	NT (hasSubclass) : Oryza sativa
	NT (hasSubclass) : Oryza perennis
	NT (hasSubclass) : Oryza rufipogon
	NT (hasSubclass) : Oryza longistaminata
	NT (hasSubclass) : Wetland rice
	NT (hasSubclass) : Oryza glaberrima
	NT (hasSubclass) : Upland rice
	NT (hasSubclass) : Oryza punctata
	RT : Rice fields
	RT : Cereal crops
	RT : Rice
EN : Rice	BT (subclassOf) : Cereals
	NT (hasSubclass) : Broken rice
	NT (hasSubclass) : Basmati rice
	RT : Rice straw
	RT : Oryza
	RT : Rice flour
	UF : Paddy

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Thesaurus data models

- Record-based data model

Term	BT	NT	RT	UF
Rice	Cereals	Broken rice Basmati rice	Rice straw Oryza	Paddy
Oryza	Poaceae	Oryza sativa Oryza perennis Oryza rufipogon Oryza longistaminata Wetland rice Oryza glaberrima Upland rice Oryza punctata	Rice fields Cereal crops Rice	

- Relation-based data model

(1) Term Entity	
TermCode	Term
1001	Term1
1002	Term2
1003	Term3
1004	Term4
1005	Term5

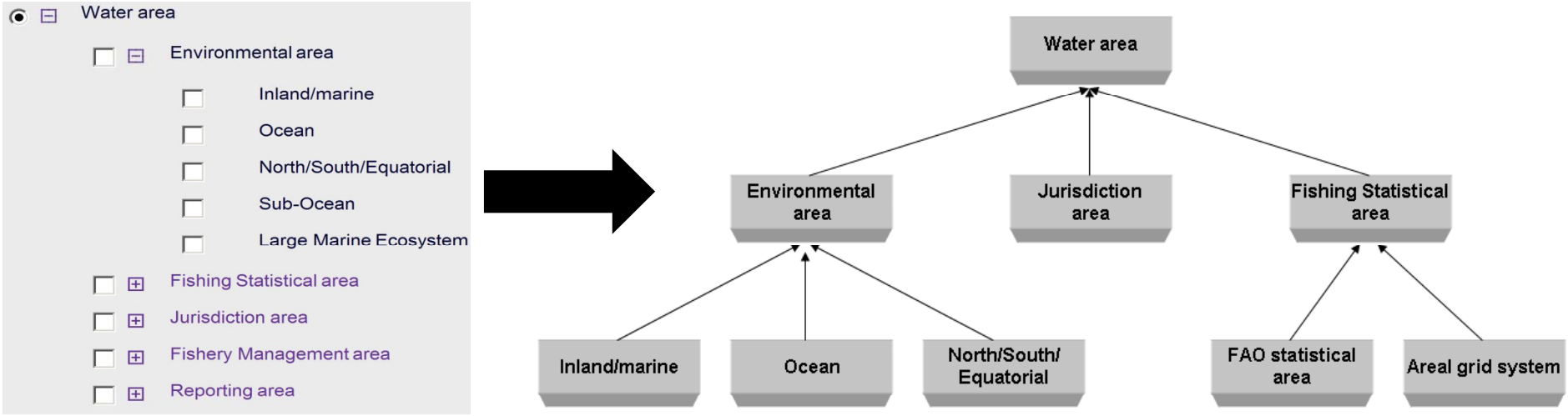
(2) Term-Term Relationship Entity		
TermCode1	TermCode2	RelID
1001	1003	10
1003	1004	20
1002	1005	10
1003	1005	30

(3) Relationship Entity		
RelID	RelDesc	RelAbr
10	Broader Term	BT
30	Related Term	RT
20	Used For	UF

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Classification schemes

- A classification scheme[1] 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 scheme[2].



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

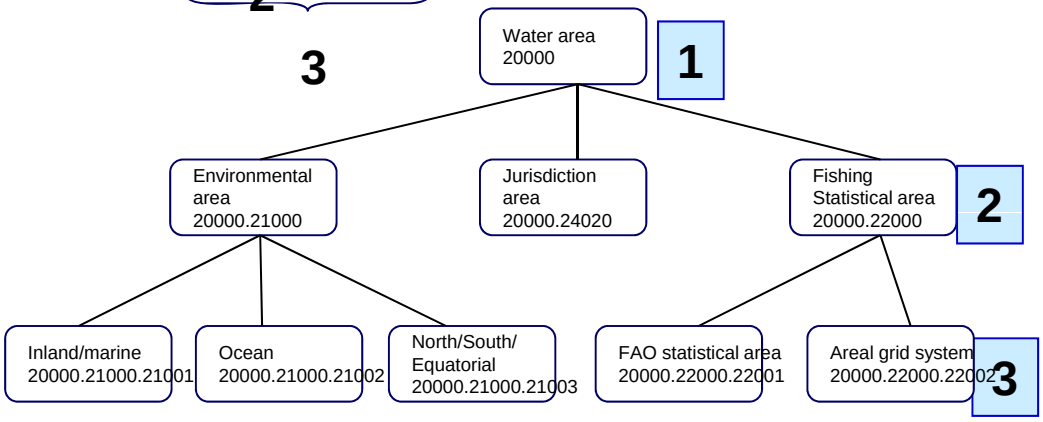
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Classification Scheme Data Models (I)

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

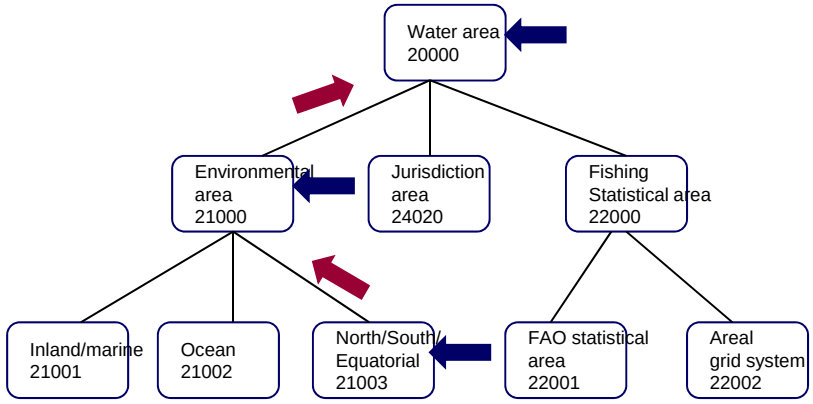
ID	CSI_Name
20000	Water area
20000.21000	Environmental area
20000.24020	Jurisdiction area
20000.22000	Fishing Statistical area
20000.21000.21001	Inland/marine
20000.21000.21002	Ocean
20000.21000.21003	North/South/Equatorial
20000.22000.22001	FAO statistical area
20000.22000.22002	Areal grid system

1
2
3



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

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



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Classification Scheme Data Models (II)

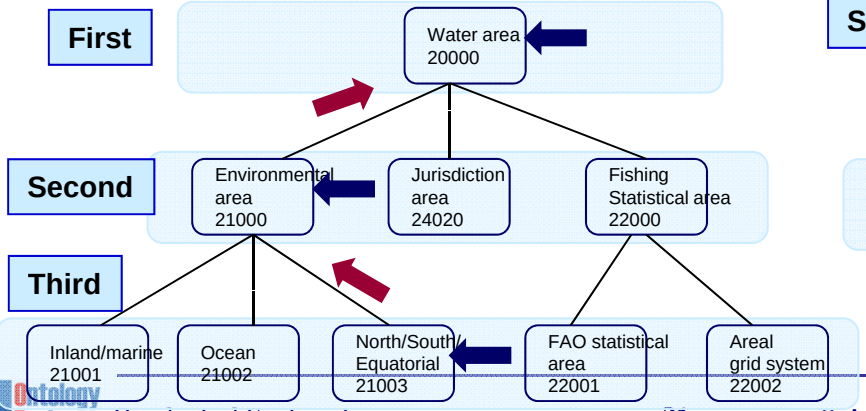
- **Snowflake Data Model** is a normalized structure for hierarchy representations. For each hierarchy level a entity is created. In this model each hierarchy node has a column linked to its parent node.

- **Flattened Data Model,** is a denormalized structure. The hierarchy is represented with an entity where each hierarchy level is stored on a different column.

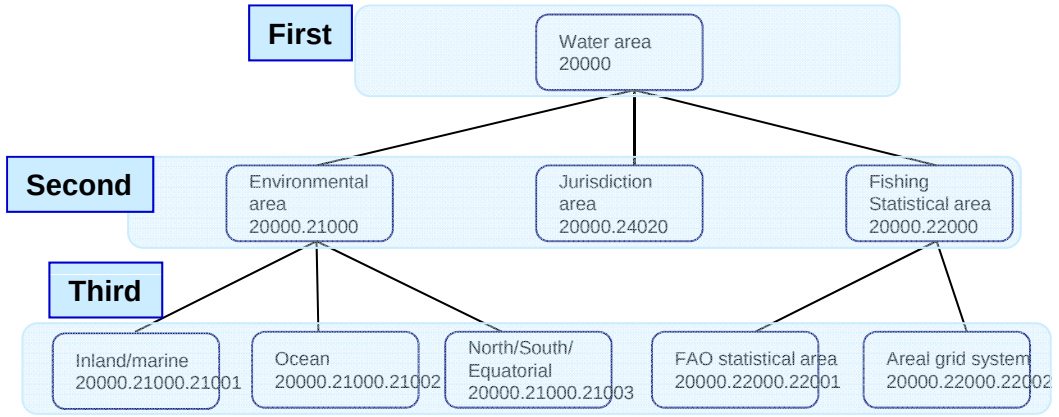
First Level	
ID	CSI_Name
20000	Water area

Second Level		
ID	First Level ID	CSI_Name
21000	20000	Environmental area
24020	20000	Jurisdiction area
22000	20000	Fishing Statistical area

Third Level		
ID	Second Level ID	CSI_Name
21001	21000	Inland/marine
21002	21000	Ocean
21003	21000	North/South/Equatorial
22001	22000	FAO statistical area
22002	22000	Areal grid system

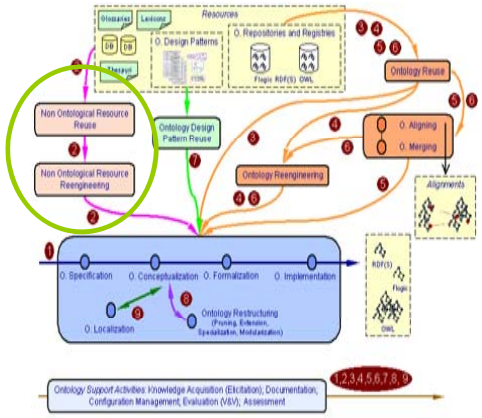


First Level		Second Level		Third Level	
ID	CSI_Name	ID	CSI_Name	ID	CSI_Name
20000	Water area	21000	Environmental area	21001	Inland/marine
20000	Water area	21000	Environmental area	21002	Ocean
20000	Water area	21000	Environmental area	21003	North/South/Equatorial
20000	Water area	22000	Fishing Statistical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

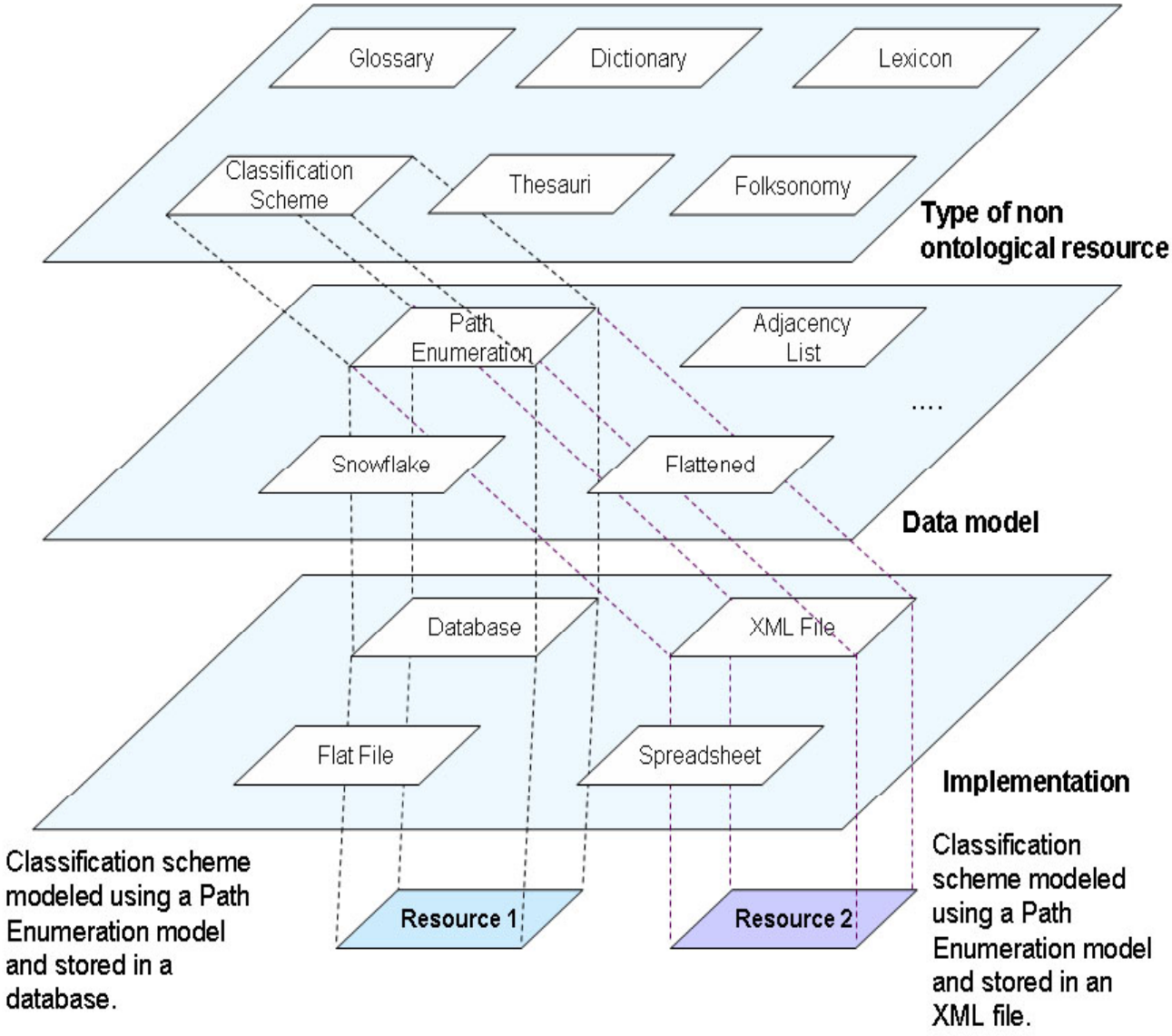


© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Types of non-ontological resources

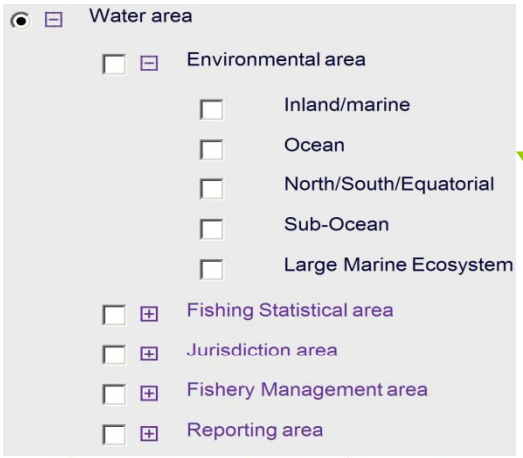


Non-Ontological Resources *are knowledge-aware resources whose semantics have not been formalized yet by means of an ontology*



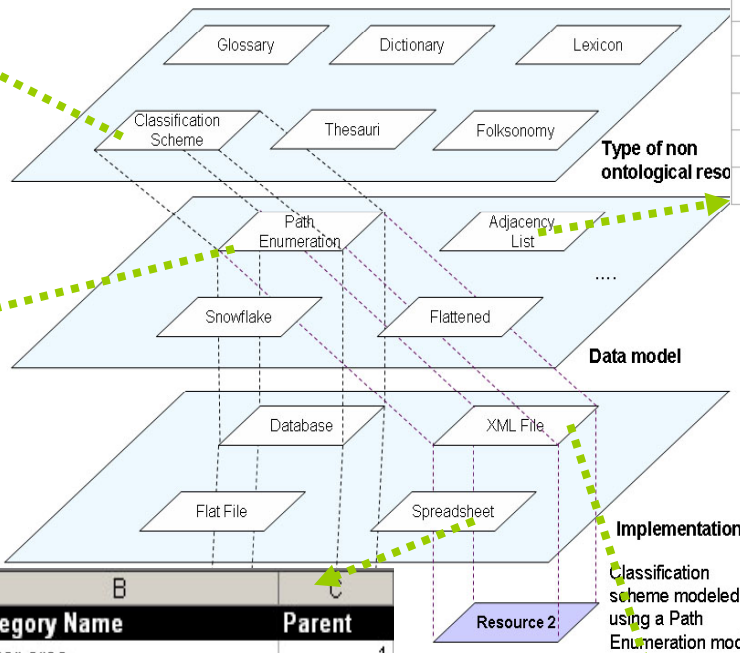
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Types of non-ontological resources



Id	Category Name	Parent
20000	Water area	1
21000	Environmental area	20000
22000	Fishing Statistical area	20000
24020	Jurisdiction area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
21004	Sub Ocean	21000
21005	Large Marine ecosystem	21000

Id	Category Name
20000	Water area
20000. 21000	Environmental area
20000.22000	Fishing Statistical area
20000. 24020	Jurisdiction area
21000.21001	Inland/marine
21000.21002	Ocean
21000.21003	North/South/Equato
21000.21004	Sub Ocean
21000.21005	Large Marine ecosys



	A	B	C
1	Id	Category Name	Parent
2	20000	Water area	1
3	21000	Environmental area	20000
4	22000	Fishing Statistical area	20000
5	24020	Jurisdiction area	20000
6	21001	Iland/marine	21000
7	21002	Ocean	21000
8	21003	North/South/Equatorial	21000
9	21004	Sub Ocean	21000
10	21005	Large Marine ecosystem	21000

```
<Classification>
  <Category>
    <NodeId>20000</NodeId>
    <WaterCategory>Water Area</WaterCategory>
    <parentNodeId>1</parentNodeId>
  </Category>
  <Category>
    <NodeId>21000</NodeId>
```

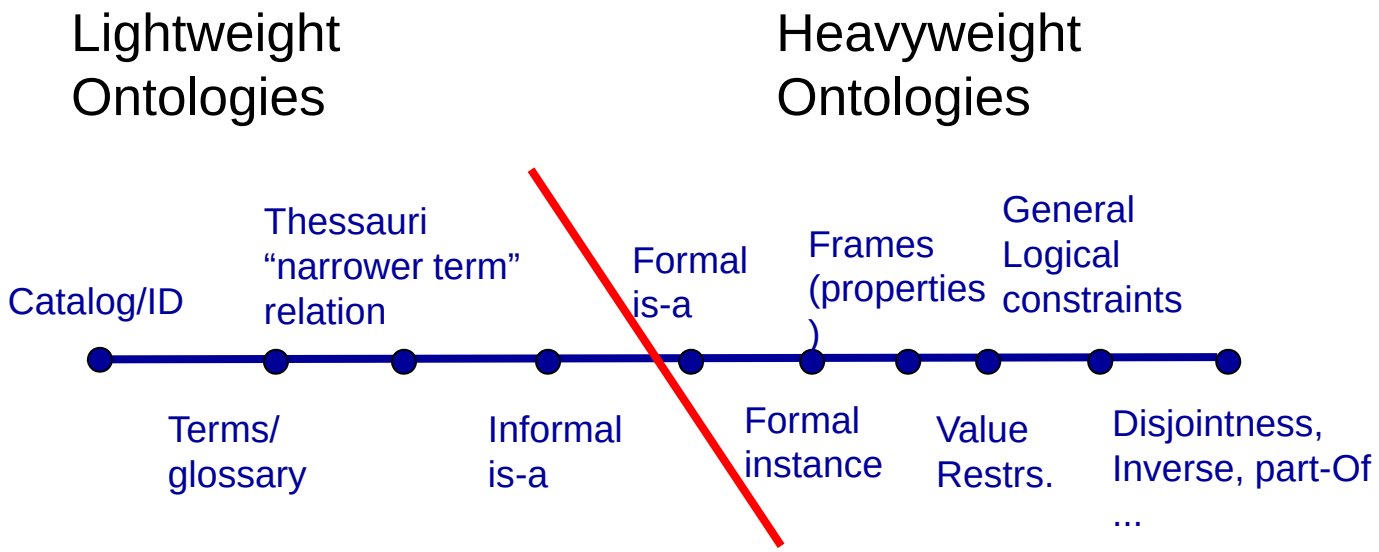

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

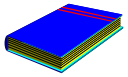
Index

- Terminology and ontologies
- Motivation
- Types of non ontological resources
- From Knowledge resources to Ontologies
- Example
- Conclusion

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Types of Knowledge-aware resources





Lassila O, McGuiness D. The Role of Frame-Based Representation on the Semantic Web. Technical Report. Knowledge Systems Laboratory. Stanford University. KSL-01-02. 2001.

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Term	BT	NT	RT	UF
Rice	Cereals	Broken rice Basmati rice	Rice straw Oryza	Paddy
Oryza	Poaceae	Oryza sativa Oryza perennis Oryza rufipogon Oryza longistaminata Wetland rice Oryza glaberrima Upland rice Oryza punctata	Rice fields Cereal crops Rice	

Thesaurus

Informal is-a

Id	Category Name	Parent
20000	Water area	1
21000	Environmental area	20000
22000	Fishing Statistical area	20000
24020	Jurisdiction area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
21004	Sub Ocean	21000
21005	Large Marine ecosystem	21000

Catalog/ID

```
NOMENCLÁTOR GEOGRÁFICO
ENTIDADES
Nación
Región geográfica
Capital de Nación
Elevación orográfica
Comunidad Autónoma
Llanura/Raso
Ciudad con Estatuto de Autonomía
Depresión orográfica
Capital de Comunidad Autónoma
Accidente costero
Provincia
Accidente marítimo
Capital de Provincia
Accidente hidrográfico
Coprincipado
Corriente fluvial
Capital de Coprincipado
Canal
Comarca
Embalse
Capital de Comarca
Lago/Laguna
Isla Humedal
Capital de Isla
Isla fluvial
Municipio
Isla marítima
Capital de Municipio
Garganta/Hoz
E.A.T.I.M.
Lugar/Paraje
Capital de E.A.T.I.M.
Paso/Collado
Población
Puerto de montaña
Comunidad de Municipios
Puerto comercial
Enclave
Helipuerto comercial
Territorio anejo
Aeródromo/Aeropuerto
Territorio autonómico
Estación de ferrocarril
Zona neutral
```

XX-YY-ZZ
02-01-02
02: transportation
01: road
02: 3-lines highway

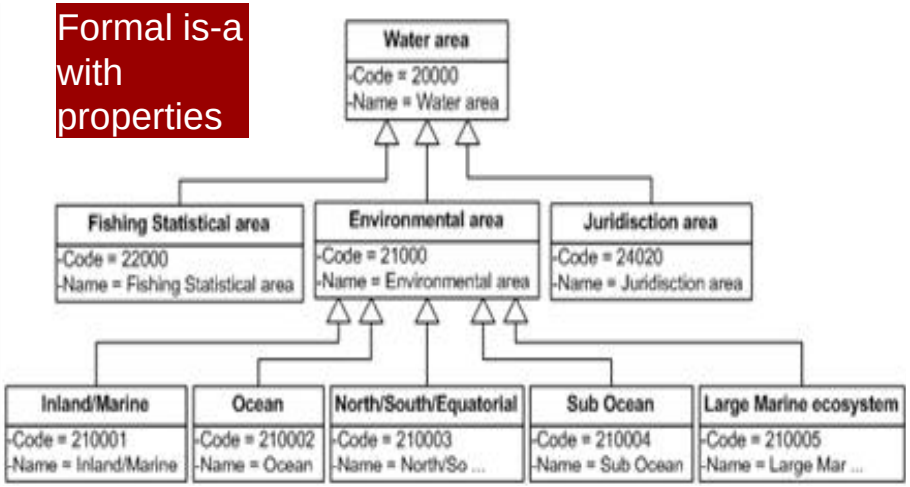
```
Diccionario de conversión DGN -> EDM.
FORMATO:
  Tipo_dgn Entidad Tipo_istram Grupo Código_bcn Cerrado Trato [

! Tipo_ dgn...NNSCCCGG                          Codigo_bcn...TTGGSS
!       NN   : Nivel elemento                          TT : Tema
!       S    : Estilo linea dgn                        GG : Grupo
!       CCC  : Color  linea dgn                        SS : Subgrupo
!       GG   : Grosor linea dgn
!
! Entidad                                       Tipo_istram....???
!       104 : polilínea
!       203 : célula se convierte a símbolo
!        -1 : célula se explota en sus componentes
!       304 : rótulo
!
! Grupo
!          0 : sin determinar
!          1 : carreteras
!          2 : hidrografía
!          3 : conducciones
!          4 : administrativo
!
!          En textos el grupo corresponde a la fuente Microstation
!
! Cerrado
!         en lineas                                    en textos
!                 1 : perimetral                              n : altur
!                 0 : entidad lineal abierta
!                -1 : cultivo perimetral
!                -2 : cultivo linea abierta
! Trato
!   I: Intocable  A: Altimetría  N: No tratar  T: Textos Asociado
!   S: Textos Sueltos  C: Cultivo  F: Solo salida !: Tratar norma
!                                                TTGGSS
02000900   104      1    0    090101   1   !I   Marco de hoja
02300902   104      2    0    100200   0   !    Base Geodésica de Ma
06003900   104      3    0    025102   0   !    Acantilado
06006900   104      4    0    025302   0   !    Costa rocosa no acan
06009900   104      5    2    037402   1   !    Playa fluvial de gui
06012900   104      6    0    025501   1   !    Lavas. Contorno
06015900   104      7    0    058303   0   !I   Dique de hormigón >1
06018900   104      8    0    058304   0   !I   Dique de hormigón <
07013400   104      9    0    058302   0   !I   Dique de tierra
07016400   104     10    0    055401   1   !    Vertedero. Contorno
11003003   104     11    1    062202   0   !    Autopista. Enlace
11012000   104     12    0    056091   1   !I   Patio. Contorno
13003300   104     13    1    060101   0   !    Autopista. Eje
13303300   104     14    1    060131   0   !    Autopista en Contruc
14002401   104     15    1    066901   1   !I   Puesto de S.O.S.
14003301   104     16    1    067901   1   !I   Peaje
15003003   104     17    1    062204   0   !    Autovía. Enlace
15003004   104     18    1    060701   0   !    Autovía
```

Implicit knowledge coded in numbers

© A. Gómez Pérez,

Formal is-a | Formal instance | Frames (properties) | Value Restrs. | General Logical constraints | Disjointness, Inverse, part-Of ...

Formal is-a with properties




```
(define-relation connects (?edge ?source ?target)
  "This relation links a source and a target by an edge. The
source and destination are considered as spatial points. The
relation has the following properties: symmetry and irreflexivity."
:def (and (SpatialPoint ?source)
          (SpatialPoint ?target)
          (Edge ?edge))
:axiom-def
((=> (connects ?edge ?source ?target)
     (connects ?edge ?target ?source)) ;symmetry
 (=> (connects ?edge ?source ?target)
     (not (or (part-of ?source ?target) ;irreflexivity
              (part-of ?target ?source))))))
```

General Logical constraints

```
(define-class Travel (?travel)
  "A journey from place to place"
:axiom-def
 (and (Superclass-Of Travel Flight)
      (Template-Facet-Value Cardinality
           arrivalDate Travel 1)
      (Template-Facet-Value Cardinality
           departureDate Travel 1)
      (Template-Facet-Value Maximum-Cardinality
           singleFare Travel 1))
:def
  (and (arrivalDate ?travel Date)
       (departureDate ?travel Date)
       (singleFare ?travel Number)
       (companyName ?travel String)))
```

Value Restrs.

```
(define-class AmericanAirlinesFlight (?X)
:def (Flight ?X)
:axiom-def
  (Disjoint-Decomposition AmericanAirlinesFlight
           (Setof AA7462 AA2010 AA0488)))

(define-class Location (?X)
:axiom-def
  (Partition Location
       (Setof EuropeanLocation NorthAmericanLocation
            SouthAmericanLocation AsianLocation
            AfricanLocation AustralianLocation
            AntarcticLocation)))
```

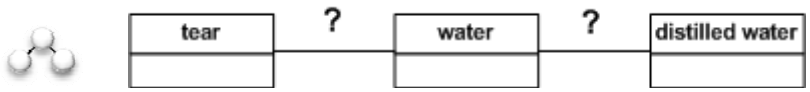
Disjointness

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

The problem

- Making explicit the semantic of the relations between concepts

```
<TERM>
<DESCRIPTOR>water</DESCRIPTOR>
 <RT>distilled water</RT>
 <RT>tear</RT>
</TERM>
```

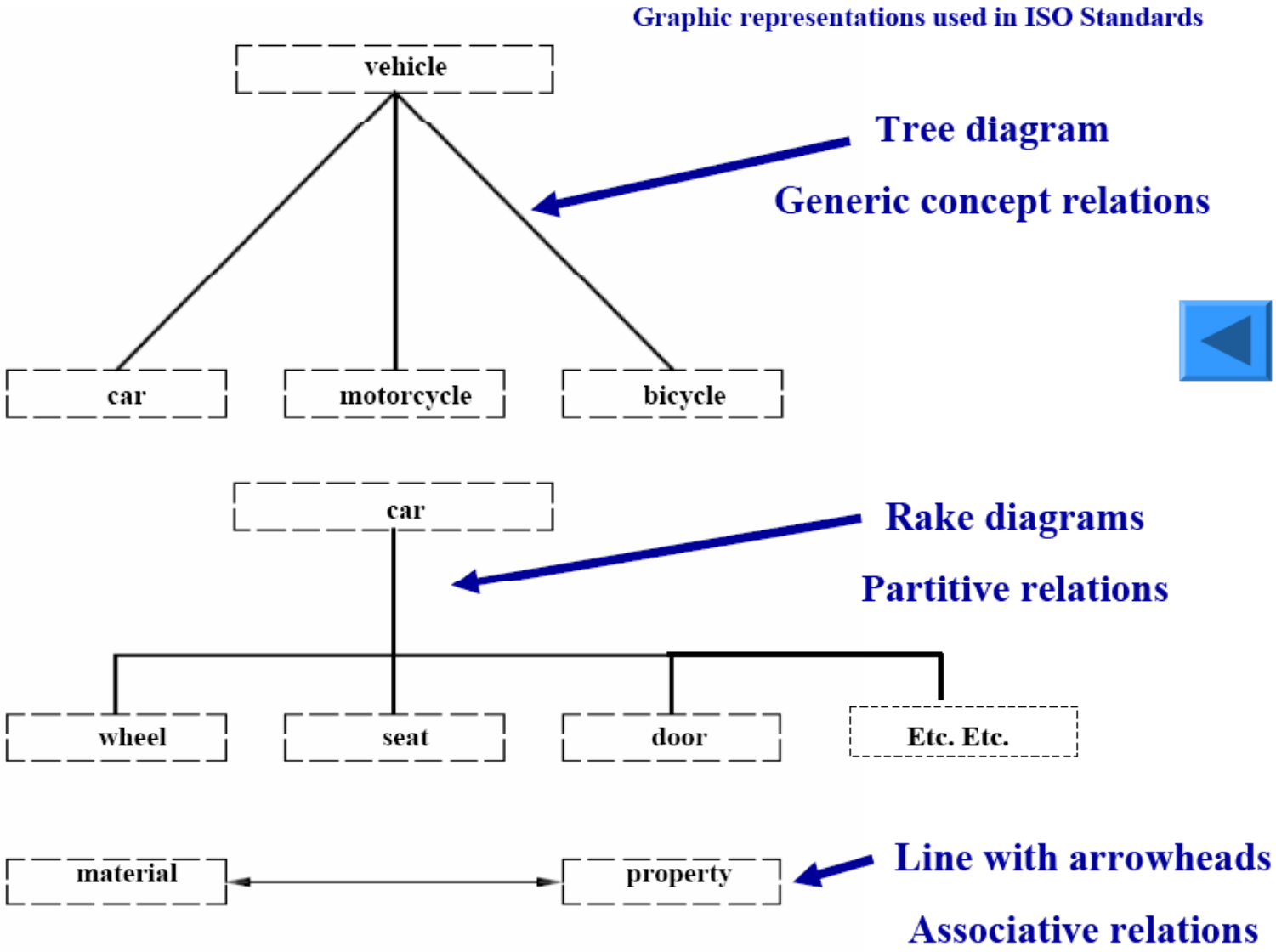


- Aproaches in the transformation

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

The problem: Discovering the relation

ID	Name
10	Vehicle
10.01	Car
10.02	Motorcycle
10.03	Bicycle
10.01	Vehicle
10.01.01	Wheel
10.01.02	Seat
10.01.03	Door

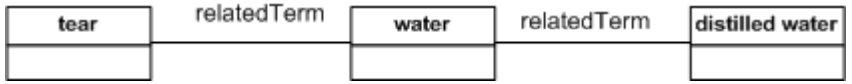


© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Semantics of the Relations among the entities

- TBox transformation: patterns must disambiguate the semantics of the relations among the NOR entities.

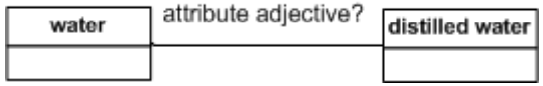
```
<TERM>
<DESCRIPTOR>water</DESCRIPTOR>
 <RT>distilled water</RT>
 <RT>tear</RT>
</TERM>
```



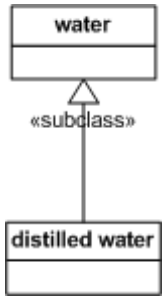
isPartOf **subclass**

1.

2.

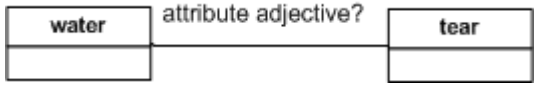


3.

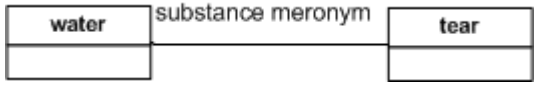


1.

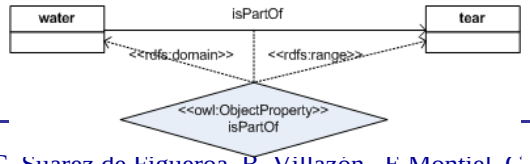
2.



4. a.



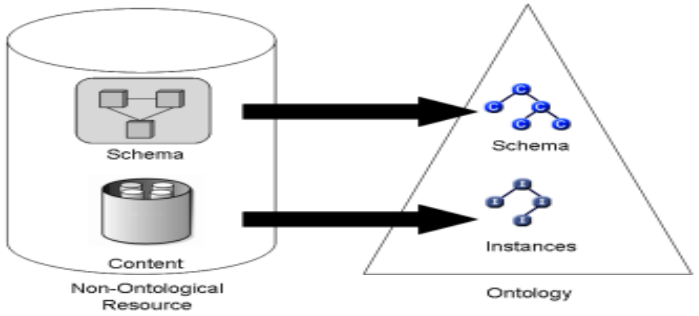
4. b.



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

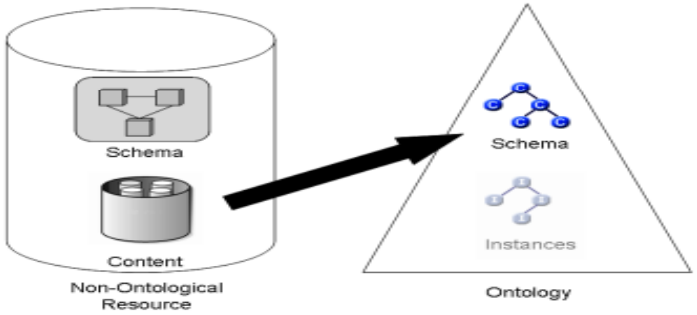
Approaches to transform resources into ontologies

ABox



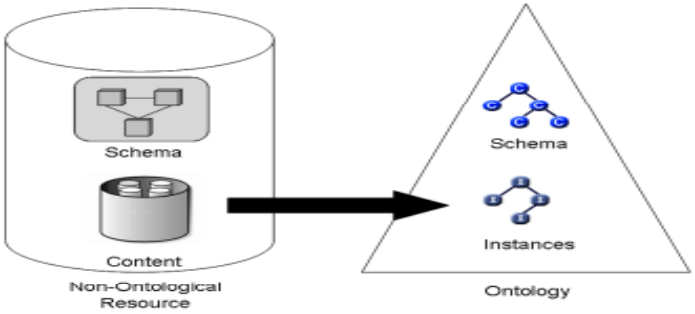
Transforming resource schema into an ontology schema, and resource content into ontology instances

TBox



Transforming resource content into an ontology schema

Population



Transforming resource content into instances of an existing ontology

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

How to transform?

- **The NeOn methodology provides**
  - **Patterns for Re-engineering Non-Ontological Resources into ontologies**
  - **A library of software patterns**
  - **Guidelines**
- **We will learn about that in the methodology lectures**

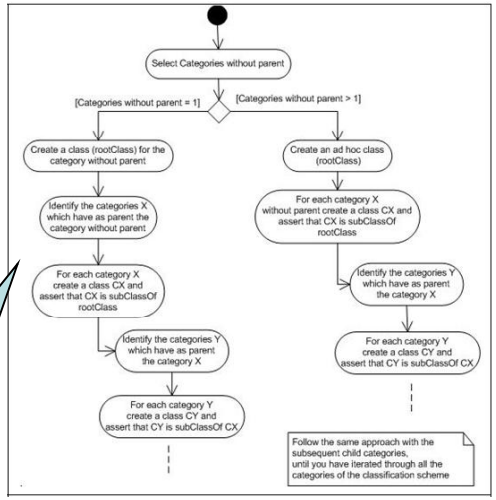
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

For the final user…

resource

Id	Category Name	Parent
20000	Water area	1
21000	Environmental area	20000
22000	Fishing Statistical area	20000
24020	Jurisdiction area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
21004	Sub Ocean	21000
21005	Large Marine ecosystem	21000

Algorithm

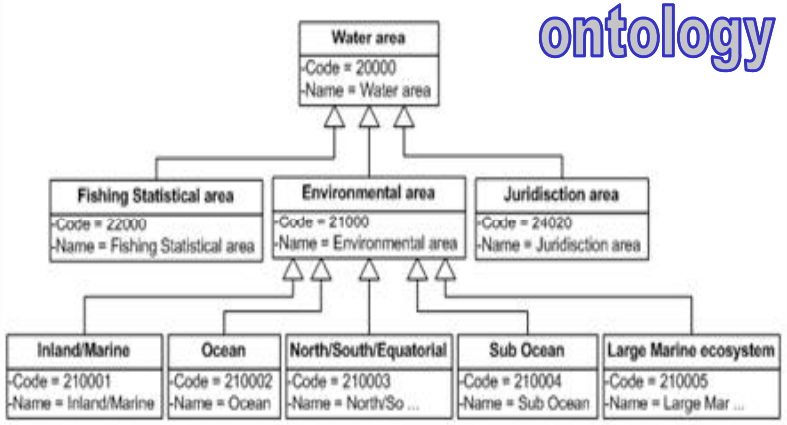


I want to transform my adjacency list-based classification into an ontology

(UML)

Example Solution Ontology

ontology



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Index

- Terminology and ontologies
- Motivation
- Types of non ontological resources
- From Knowledge resources to Ontologies
- Example
- Conclusion

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Looking for an European Employment

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

The Goal: Helping Job Seekers on their way

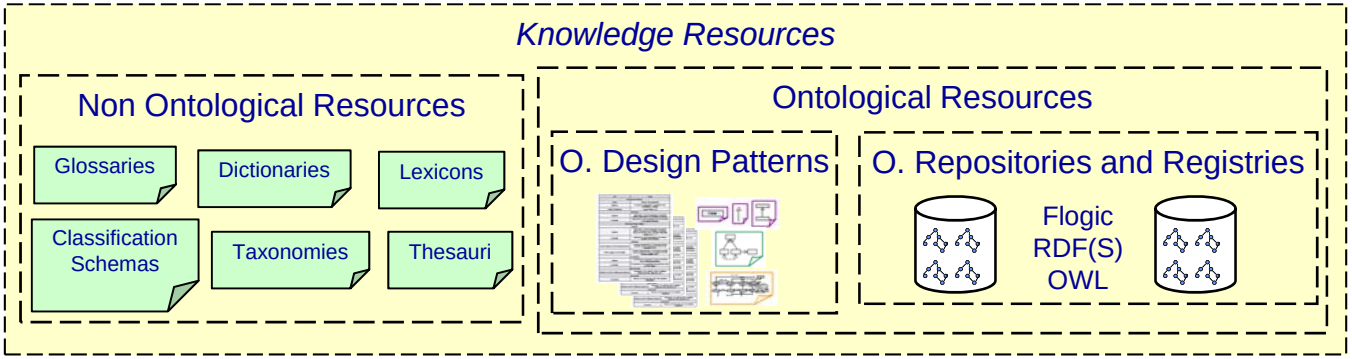
LEGENDA

- Requester ES
- Responding ES
- ES not involved
- Cand. — Job Seeker's Candidacy
- Vacan. — Employer Job Vacancy

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Searching Resources

- Use the terminology from the ORSD
- Find resources covering the terminology



Objects

Objects in the universe of discourse, which are instances of:

- Job Category
  - O1. Computer System Designer
  - O2. Computer System Analyst
  - O3. Programmer
  - O4. Computer Engineer
  - O5. Computer Assistant
  - O6. Computer Equipment Operator
  - O7. Industrial Robot Controller
  - O8. Telecommunication Equipment Operator
  - O9. Medical Equipment Operator
  - O10. Electronic Equipment Operator
  - O11. Image Equipment Operator
- Nationality
  - O12. Austrian
  - O13. Belgian
  - O14. Danish
  - O15. Estonian
  - O16. Finnish
  - O17. French
  - O18. German
  - O19. Greek
  - O20. Italian

- Where:
  - Internet
  - Standardization bodies (ISO,…)
  - Intranet of the organization
  - Ontology Registries

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Search and Select non-ontological resources

- *We select the most appropriate standards and taxonomies for:*
  - Occupation Classification
    ISCO-88 (COM), SOC, ISCO-88, ONET, Eures Taxonomy.
  - Classification of Economic Activities
    ISIC Rev. 3.1, NACE Rev. 1.1, NAICS
  - Apprenticeship classifications
    ISCED 97, FOET
  - Currency Classification
    ISO 4217
  - Geography Classification
    ISO 3166, Eures Taxonomy

Language Classification
ISO 6392, CEF
Driving License Classification
European Legislation
Skill Classification
Eures Taxonomy
Contract Types Classification
LE FOREM, Eures and BLL Classification
Work Condition Classification
LE FOREM, Eures and BLL Classification

Is the terminology included in the Ontology Requirements Specification Document covered by the resources?

ISO 4217 (currencies)

Entitiy	Currency	Code	
		Alphabetic	Numeric
AFGHANISTAN	Afghani	AFN	971
ALBANIA	Lek	ALL	008
ALGERIA	Algerian Dinar	DZD	012
AMERICAN SAMOA	US Dollar	USD	840
ANDORRA	Euro	EUR	978
ANGOLA	Kwanza	AOA	973
ANGUILLA	East Caribbean Dollar	XCD	951
ANTARCTICA	No universal currency		
ANTIGUA AND BARBUDA	East Caribbean Dollar	XCD	951
ARGENTINA	Argentine Peso	ARS	032
ARMENIA	Armenian Dram	AMD	051
ARUBA	Aruban Guilder	AWG	533
AUSTRALIA	Australian Dollar	AUD	036
AUSTRIA	Euro	EUR	978
AZERBAIJAN	Azerbaijanian Manat	AZN	944
BAHAMAS	Bahamian Dollar	BSD	044
BAHRAIN	Bahraini Dinar	BHD	048
BANGLADESH	Taka	BDT	050
BARBADOS	Barbados Dollar	BBD	052
BELARUS	Belarussian Ruble	BYR	974

ISO 3166 (countries)

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?>
<ISO_3166-1_List_en xml:lang="en">
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>AFGHANISTAN</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AF</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ÅLAND ISLANDS</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AX</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ALBANIA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AL</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ALGERIA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>DZ</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>AMERICAN SAMOA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AS</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ANDORRA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AD</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ANGOLA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AO</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ANGUILLA</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>AI</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
```

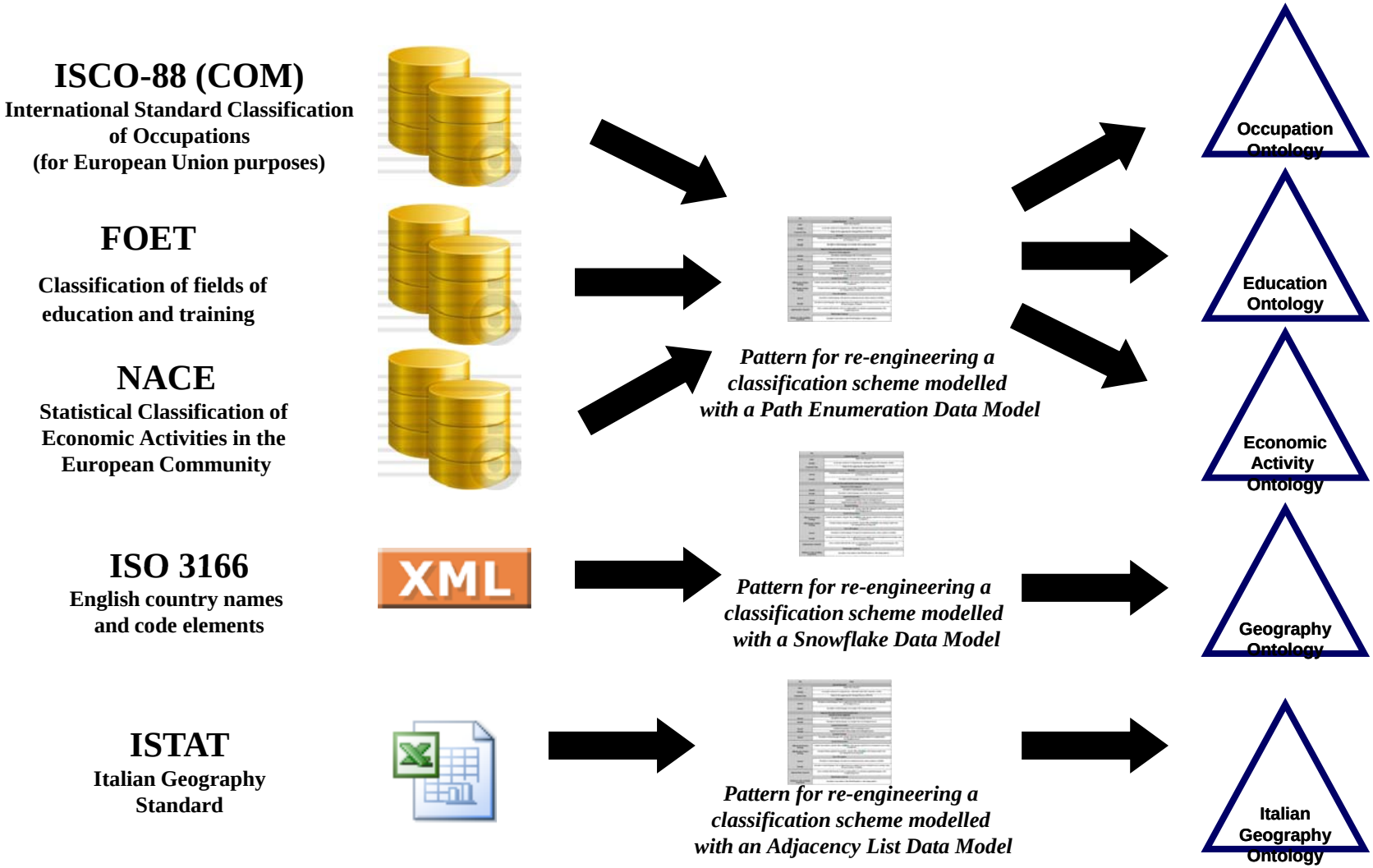

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

Multilingual Non-ontological resources - ISCO-88 (COM)

level	description EN	description FR	description DE	texte auto EN	
3	Religious professionals	Membres du clergé	Geistliche, Seelsorger		
3	Public service administrative professionals	Cadres administratifs des services publics	Wissenschaftliche Verwaltungsfachkräfte des öffentlichen Dienstes	This is a new minor group, designed explicitly for the classification of occupations in which the primary tasks consist of general administrative functions within the public	Hier han ausdrück deren Ha
3	Physical and engineering science technicians	Techniciens des sciences physiques et techniques	Material- und ingenieurtechnische Fachkräfte		
3	Computer associate professionals	Pupitreurs et autres opérateurs de matériels informatiques	Datenverarbeitungsfachkräfte	If the job title and associated information on activities does not permit a clear distinction, additional information on a level of relevant qualifications or description of tasks may	Wenn di Informati erlauben
3	Optical and electronic equipment operators	Techniciens d'appareils optiques et électroniques	Bediener optischer und elektronischer Anlagen		
3	Ship and aircraft controllers and technicians	Techniciens des moyens de transport maritime et aérien	Schiffs-, Flugzeugführer und verwandte Berufe		
3	Safety and quality inspectors	Inspecteurs d'immeubles, de sécurité, d'hygiène et de qualité	Sicherheits- und Qualitätskontrolleure		
3	Life science technicians and related associate professional	Techniciens et travailleurs assimilés des sciences de la vie et de la santé	Biotechniker und verwandte Berufe		
3	Health associate professionals (except nursing)	Professions intermédiaires de la médecine moderne (à l'exception du personnel infirmier)	Medizinische Fachberufe (ohne Krankenpflege)		
3	Nursing and midwifery associate professionals	Personnel infirmier et sages-femmes (niveau intermédiaire)	Nicht-wissenschaftliche Krankenpflege- und Geburtshilfefachkräfte	Concerning "Nursing and midwifery professionals", see notes to sub-major group 22.	Für "Wis Geburtsh
3	Primary education teaching associate professionals	Professions intermédiaires de l'enseignement primaire	Nicht-wissenschaftliche Lehrkräfte des Primarbereiches		
3	Pre-primary education teaching associate professionals	Professions intermédiaires de l'enseignement préprimaire	Nicht-wissenschaftliche Lehrkräfte des Vorschulbereiches		
3	Special education teaching associate professionals	Professions intermédiaires de l'éducation des handicapés	Nicht-wissenschaftliche Sonderschullehrkräfte		

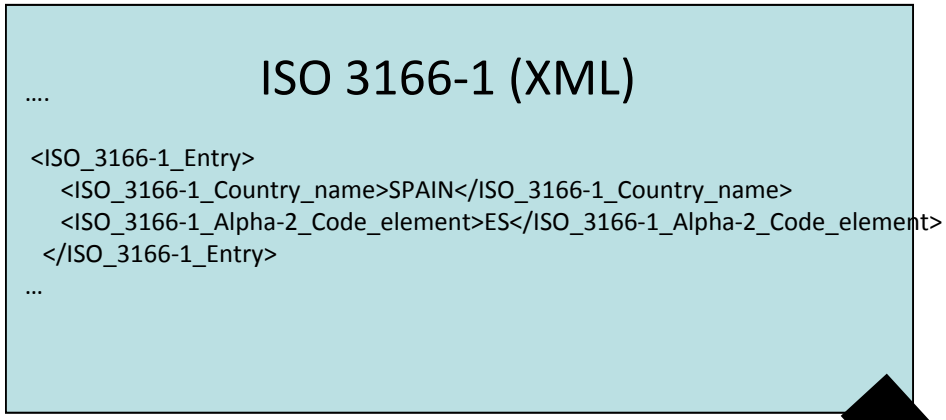
© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

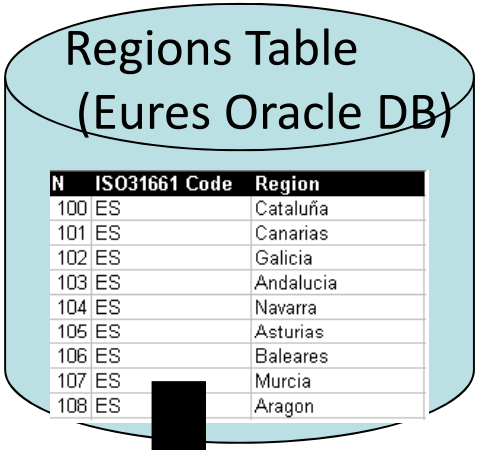
Pattern based approach for re-engineering non ontological resources



© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza

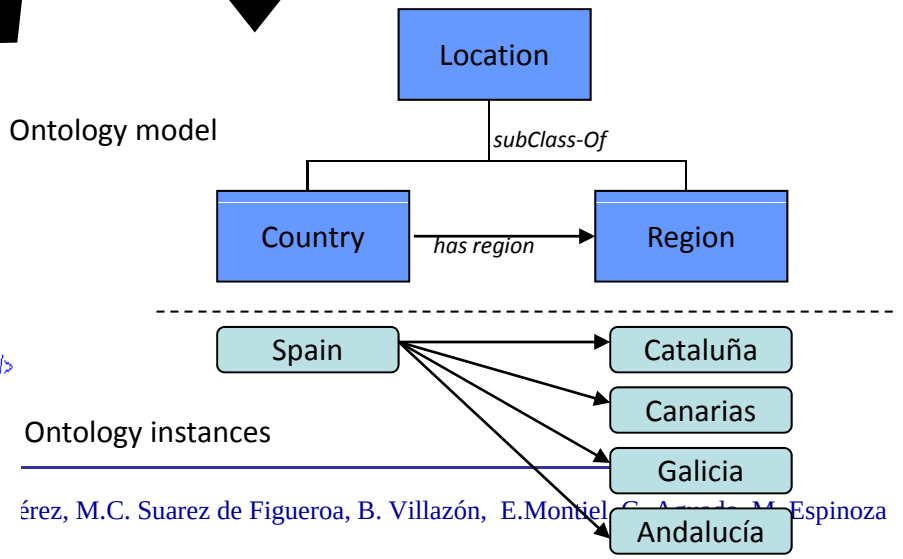
Knowledge Resource Re-engineering and Aggregation





Excerpt of the Geography Ontology

```
<rdf:Description rdf:about="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Country_SPAIN">
  <rdf:type rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Country"/>
  <GeoOnt:Code rdf:datatype="http://www.w3.org/2001/XMLSchema#string">ES</GeoOnt:Code>
  <GeoOnt:Name rdf:datatype="http://www.w3.org/2001/XMLSchema#string">SPAIN</GeoOnt:Name>
  <GeoOnt:is_located_in_Continent rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#EU_Europe"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Catalunya"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Canarias"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Galicia"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Andalucia"/>
</rdf:Description>
```



Conclusions

1. The reuse of non-ontological resources that have been reached some degree of consensus in a community allows the development of ontologies easier and quicker

2. **The NeOn methodology facilitates the reuse and reengineering of non ontological resources into ontologies**

© A. Gómez Pérez, M.C. Suarez de Figueroa, B. Villazón, E.Montiel, G. Aguado, M. Espinoza