An Insight into Ontologies, Semantic Web and NLP

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Outline

1. Semantic web
2. Ontologies: methodologies, tools, languages
3. Ontology Learning
4. Ontology Annotation tools

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Semantic Web – the full potential Wel

from Ontoweb

- New & Next generation of the Web.
- The semantic web is an extension of the current web
- The Semantic Web will provide automated services based on machine-processable semantics of data and heuristics that make use of these data.

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Ontology – Consensual Understanding

- The key asset for the Semantic Web
  - Ontology: shared and common domain theories
  - It describes the semantics of a domain in a human-understandable and computer-processable way
  - A crucial role to enable content-based *access*, *interoperability*, and *communication* across the Web

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Esperonto IST-2001-34373

http://www.esperonto.net

Application Service Provision of Semantic Annotation, Aggregation,

Indexing and Routing of Textual, Multimedia, and Multilingual Web Content

Goals

1. To bridge the gap between the current web and the Semantic Web: SemASP
   - Ontology-based annotation
   - Sources:
     - Estatic pages
     - Pages dinamically generated from DB
     - Textual multimedia information
     - Web services
2. Added value knowledge-based services on top of the constructed semantic web
   - Routing based on P2P communication
   - Semantic aggregation
   - Meaning negotiation
3. Multilinguality on ontology construction, ontology-based annotation, P2P routing,

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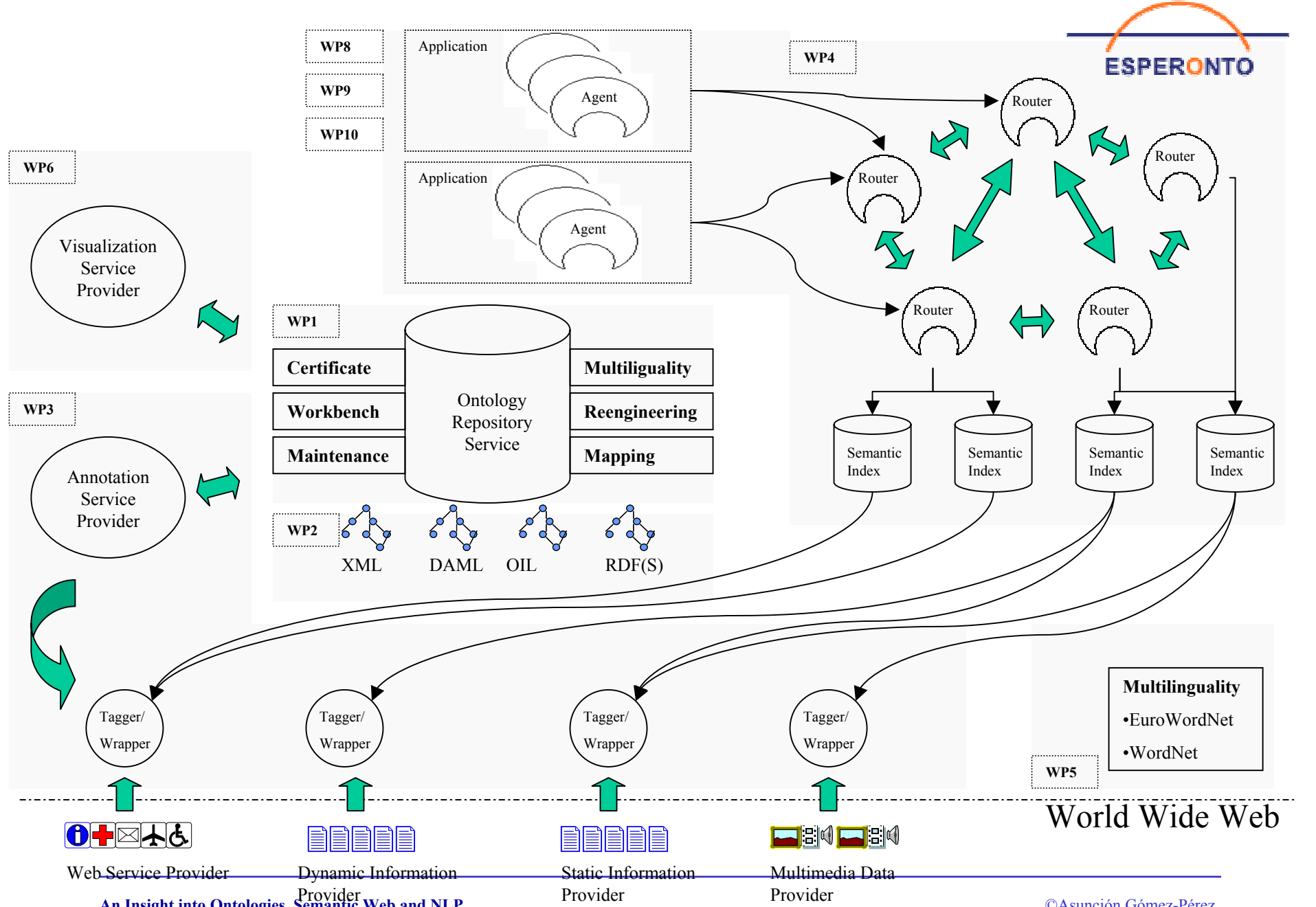

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4. Ontology-based Annotation

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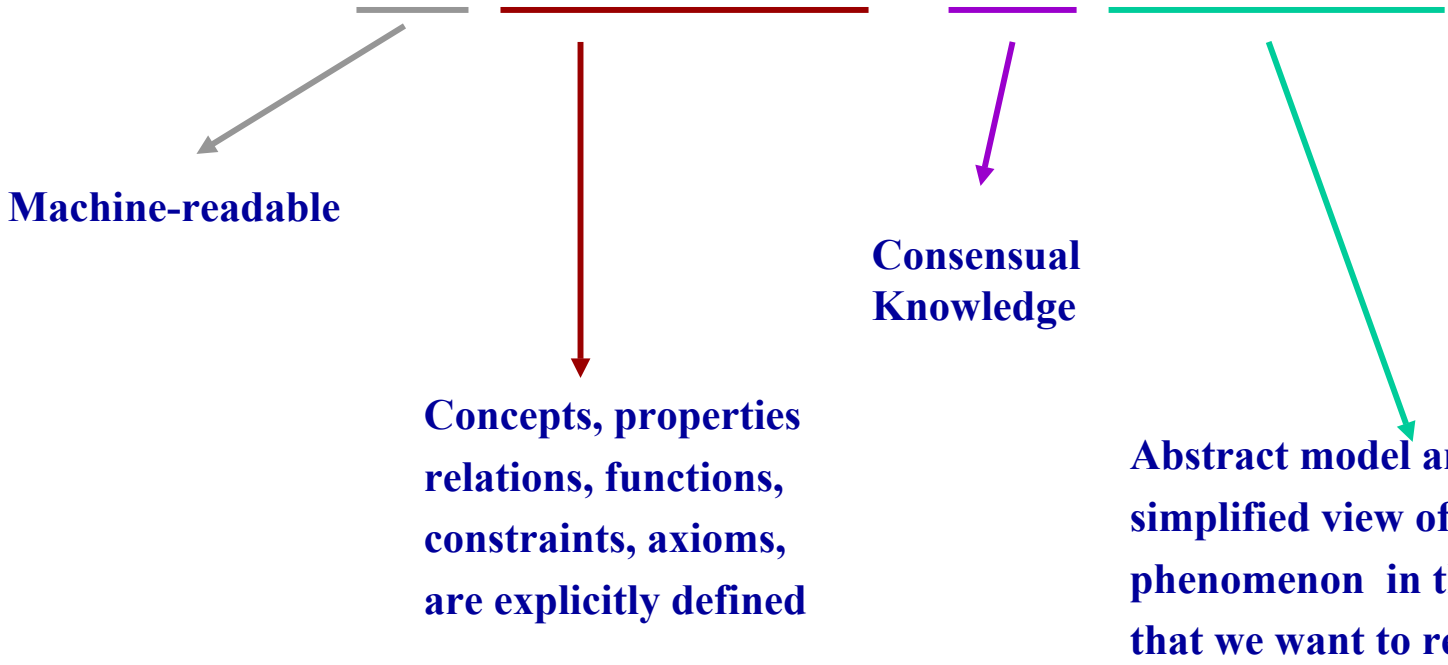
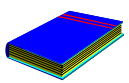
Definitions of Ontologies

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





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

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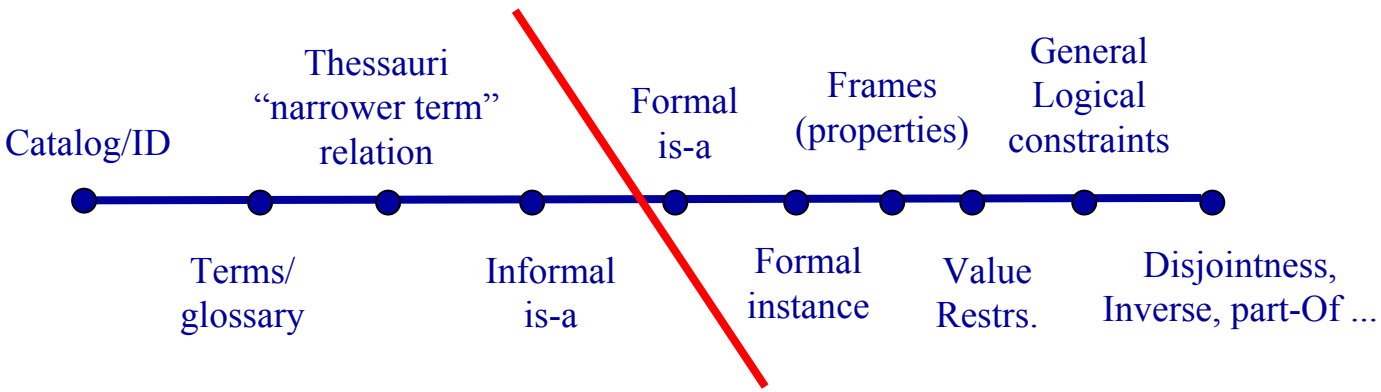
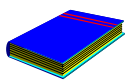
Types of Ontologies
Lassila and McGuiness classification

Lightweight Ontologies

Heavyweight Ontologies





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.

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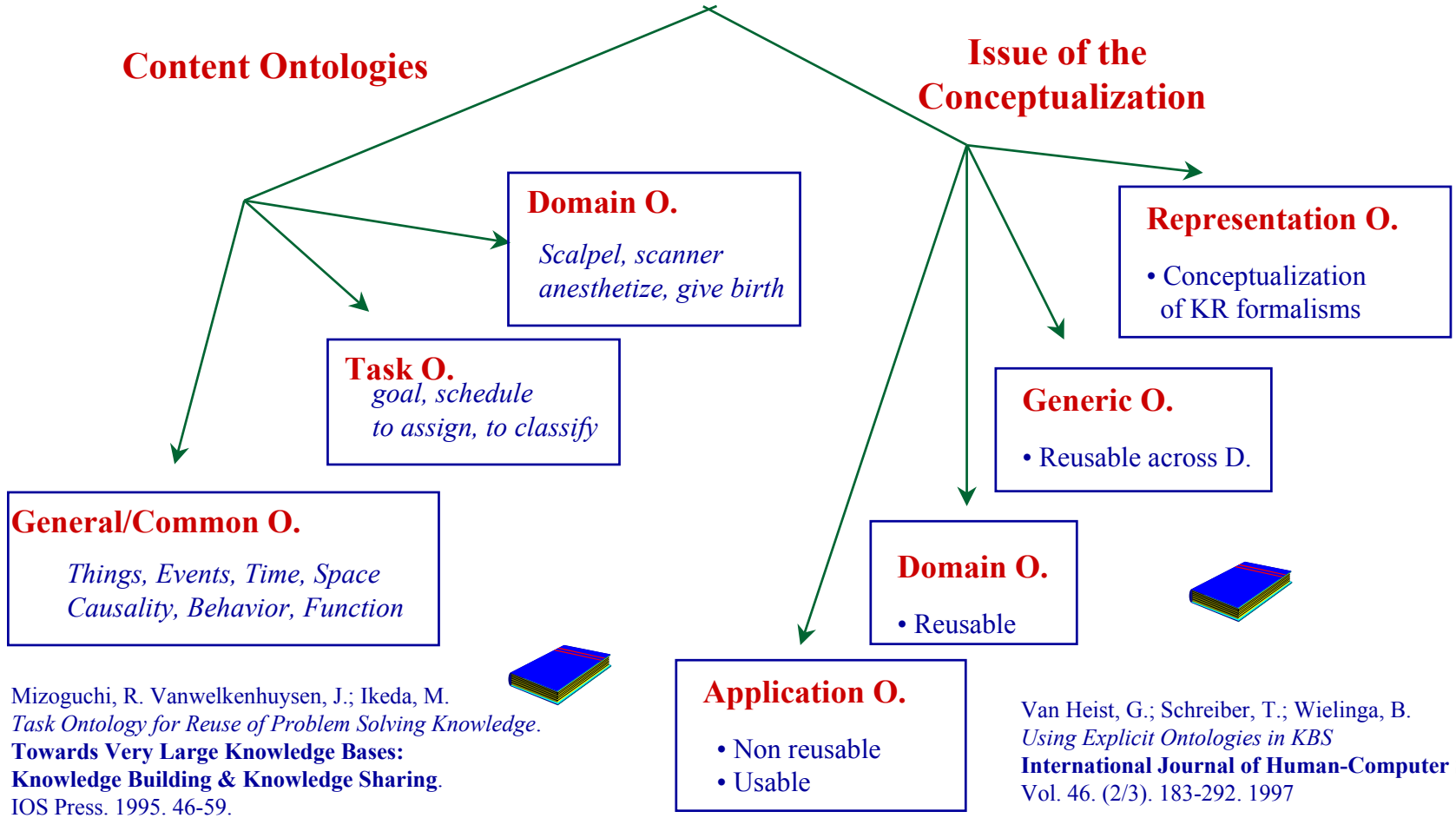
Types of Ontologies



Mizoguchi, R. Vanwelkenhuysen, J.; Ikeda, M.
Task Ontology for Reuse of Problem Solving Knowledge.
Towards Very Large Knowledge Bases:
Knowledge Building & Knowledge Sharing.
IOS Press. 1995. 46-59.

Van Heist, G.; Schreiber, T.; Wielinga, B.
Using Explicit Ontologies in KBS
International Journal of Human-Computer Studies.
Vol. 46. (2/3). 183-292. 1997

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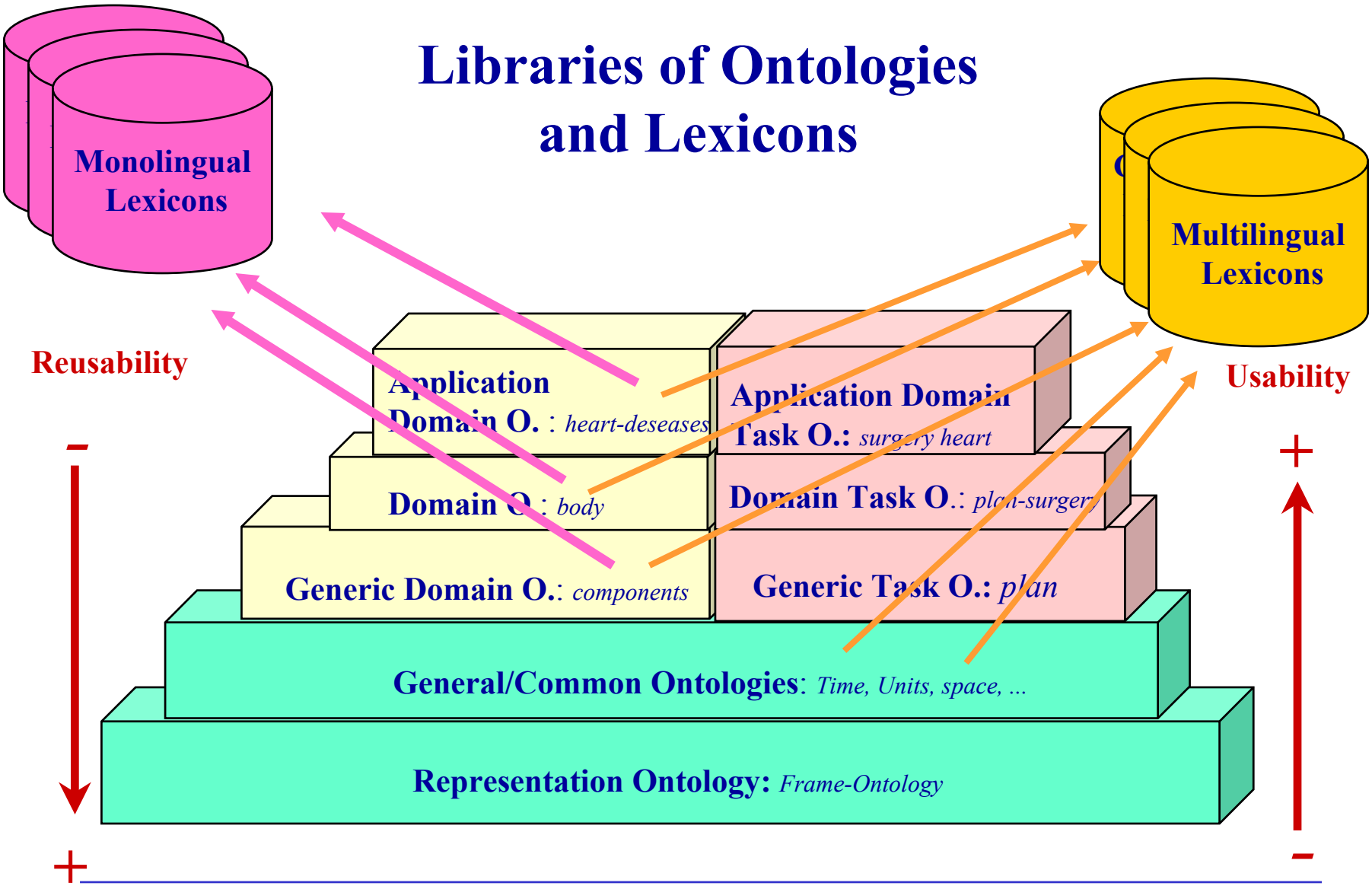
Libraries of Ontologies and Lexicons



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Ontological Commitments

Agreements to use the vocabulary in a coherent and consistent manner

An agent commits (conforms) to an ontology if it "acts" consistently with the definitions

What is a flight?

What are the Ontological Commitments for the term flight?

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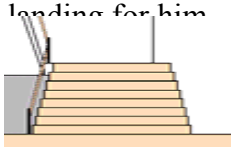
ontological commitments

flight

OC_1 A formation of aircraft in flight

OC_2 An instance of travelling by air

OC_3 A set or steps between one floor or landing for him

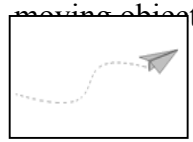


OC_4 The act of escaping physically

OC_5 A unit of the US air force smaller than a squadron

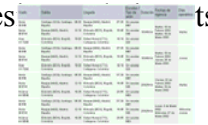
OC_6 Passing above and beyond

OC_7 The path followed by a moving object



OC_8 A flock of flying birds

OC_9 A scheduled trip by plane between destinations



(define-class flight (?flight)
"A travel by plane, which is identified by a flight number"
:def (and (travel ?flight) (Has-One ?flight flight-number)
:class-slots ((transportMean "plane")))

flight

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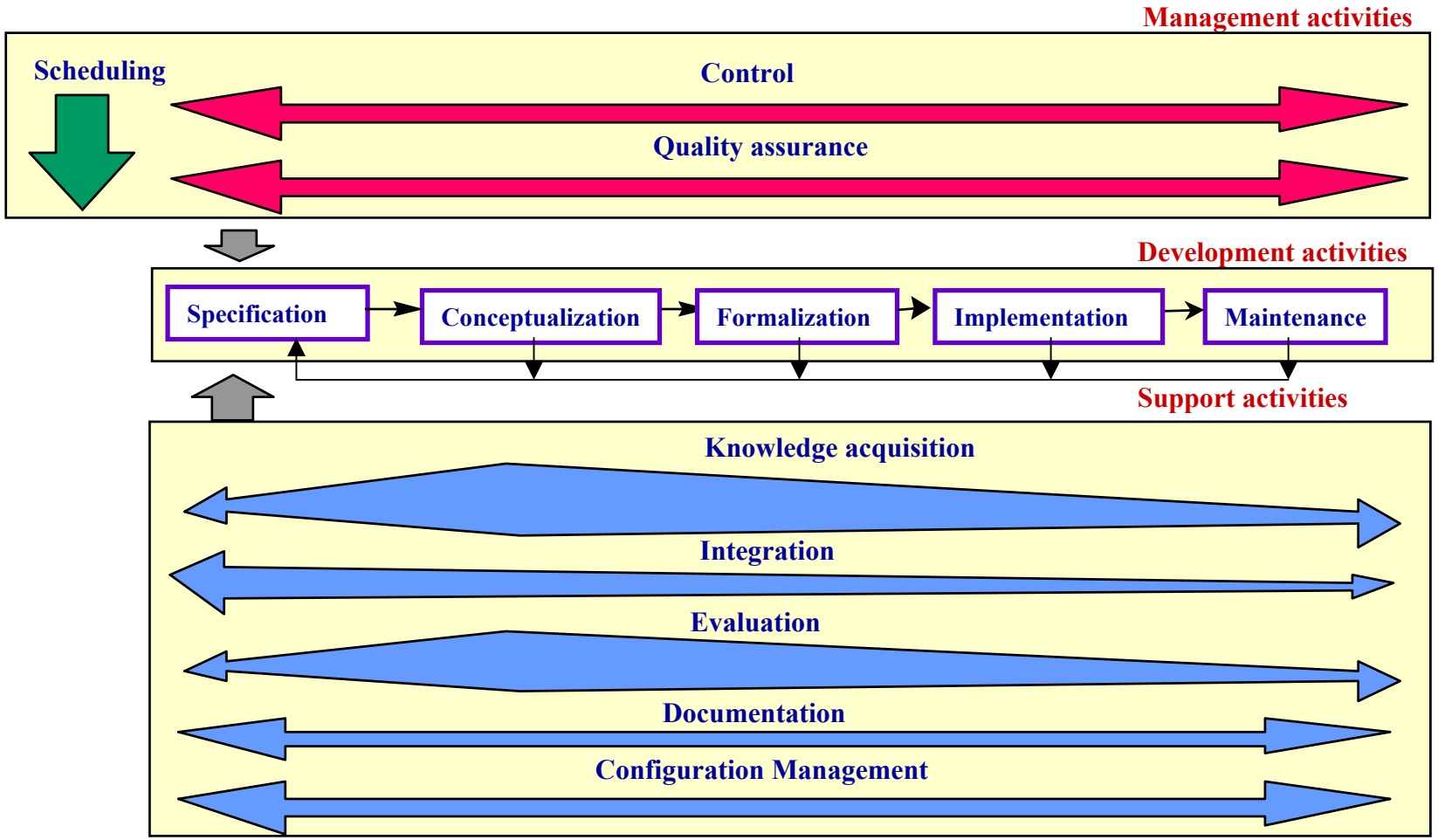
Intra-dependencies

Ontology Life Cycle



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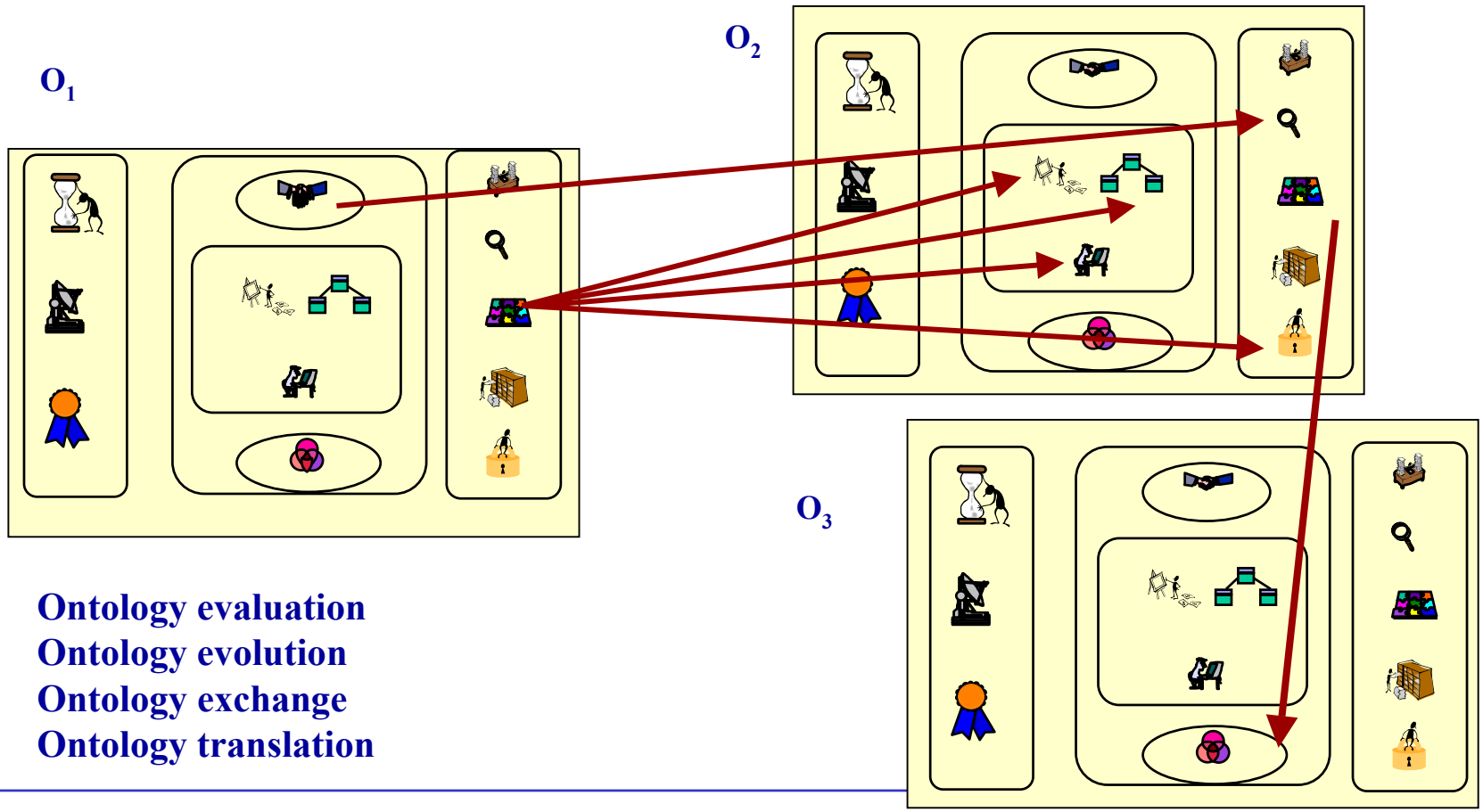
Inter-dependencies

Inter-dependencies refer the relationship between activities carried out when building different ontologies



Ontology evaluation
Ontology evolution
Ontology exchange
Ontology translation

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Overview of ontology languages

Ontoweb WP1: D1.1

http://www.ontoweb.org

OntoRoadMap

http://babage.dia.fi.upm.es/ontoweb/wp1/OntoRoadMap/index.html

SIG2 on Ontology Languages

- **Web Pages at http://www.cs.man.ac.uk/~horrocks/OntoWeb/SIG/**
- **Mailing list: ontoweb-language-sig@cs.man.ac.uk**

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Ontology languages

Traditional languages

CARIN	**URL:** ***Not available***
FLogic	**URL:** ***No URL available***
LOOM	**URL:** http://www.isi.edu/isd/LOOM/LOOM-HOME.html
OCML	**URL:** http://kmi.open.ac.uk/projects/ocml/
Ontolingua	**URL:** http://ontolingua.stanford.edu

Web-based ontology languages

SHOE	**URL:** http://www.cs.umd.edu/projects/plus/SHOE/
XOL	**URL:** http://www.ai.sri.com/~pkarp/xol/
OML	**URL:** http://www.ontologos.org/OML/OML%200.3.htm
RDF and RDF Schema	**URL:** http://www.w3.org/TR/rdf-schema/
OIL	**URL:** http://www.ontoknowledge.org/oil/
DAML+OIL	**URL:** http://www.daml.org/language/
OWL	**URL:** http://www.w3.org/TR/owl-ref/

Other ontology specification languages

CycL	**URL:** http://www.cyc.com/cycl.html
GRAIL	**URL:** http://www.opengalen.org/open/CRM/index.html

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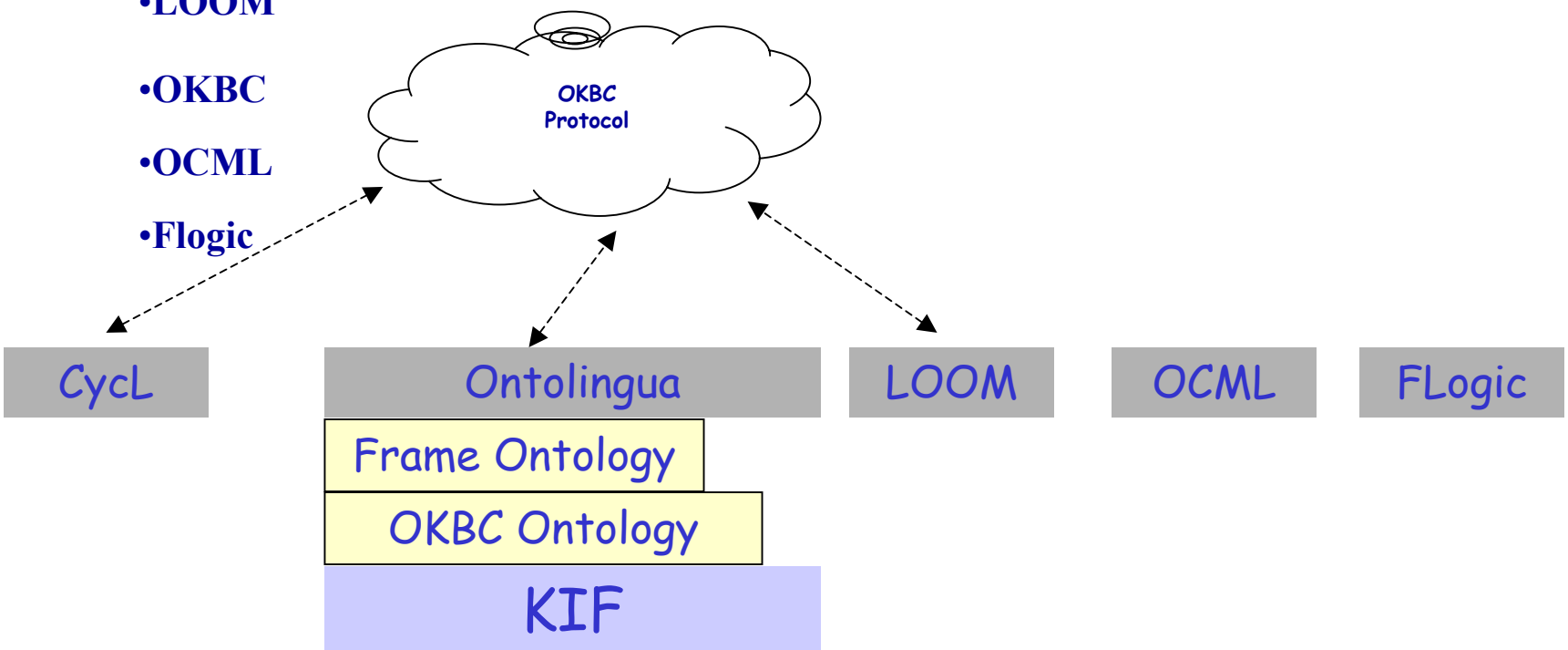
Ontology Languages

Traditional ontology languages

- Ontolingua/KIF
- LOOM
- OKBC
- OCML
- Flogic



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Ontology Languages

Traditional ontology languages

- Ontolingua/KIF
- LOOM
- OKBC
- OCML
- Flogic

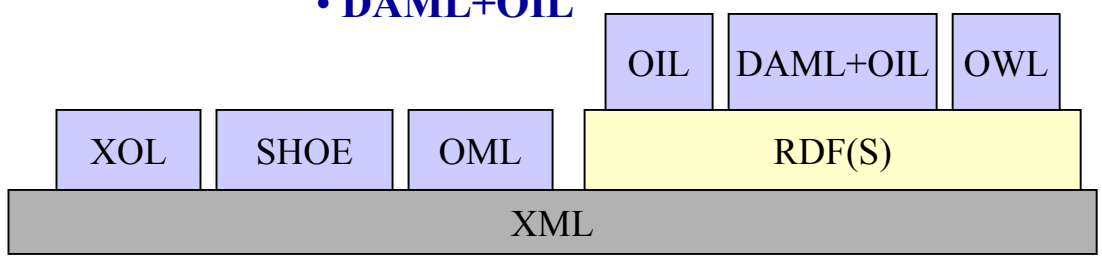
Standards & Recommendations of W3C

- XML
- RDF(S)
- OWL

Other ontology languages

- SHOE
- XOL
- OML/CKML
- OIL
- DAML+OIL

expressivity



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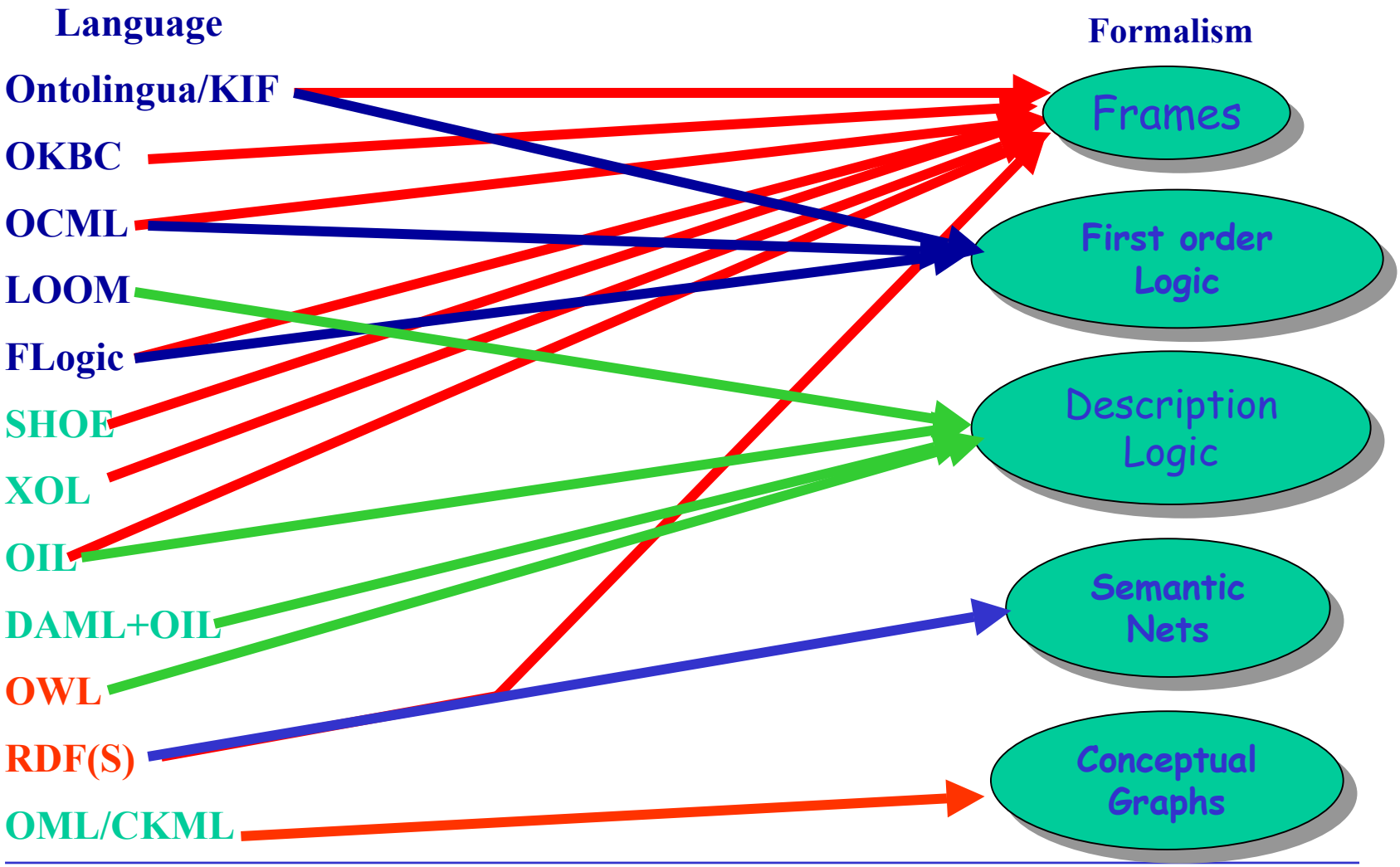
KR Formalisms



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Which language should I choose?

- High expressiveness needs → Traditional languages
- Automatic Classifications → Description logic
- Ontology exchange → Web-based languages
- Agent-based architectures
  - Ontology exchange → Web-based languages
  - Reasoning → Traditional languages

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Overview of ontology tools

Ontoweb WP1: D1.1 and D1.3

http://www.ontoweb.org

OntoRoadMap

http://babage.dia.fi.upm.es/ontoweb/wp1/OntoRoadMap/index.html

SIG3 on Enterprise-Standard Ontology Environments SIG

- **Web Pages at http://delicias.dia.fi.upm.es/ontoweb/sig-tools/**
- **Two mailing lists**
  - **suscribe: ontoweb-sigtools-request@delicias.dia.fi.upm.es**
  - **send comments: ontoweb-sigtools@delicias.dia.fi.upm.es**

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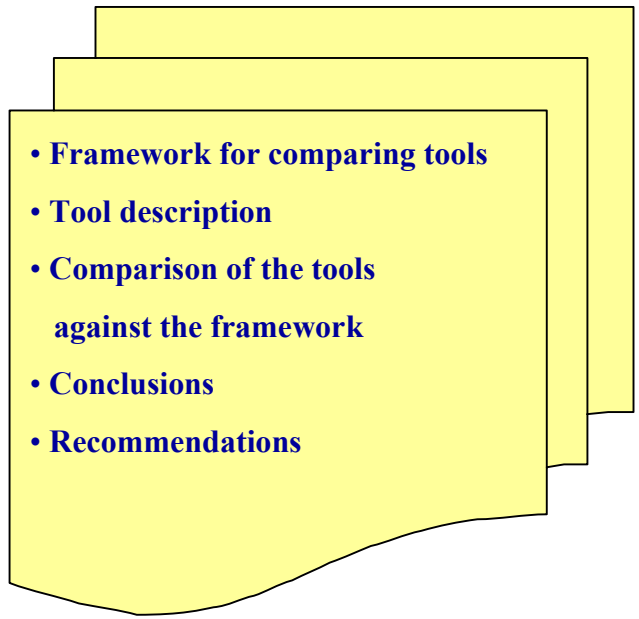
D1.3.: A survey on Ontology Tools

Content:

- **Ontology building Tools**
- **Ontology merge and Integration Tools**
- **Ontology Evaluation Tools**
- **Ontology-based Annotation Tools**
- **Ontology Storage and Querying Tools**

Contributors:

- **WP1 Partners**
- **SIG3 Participants**



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Overview of ontology tools (I)

Environments for building ontologies

APECKS	**URL:** ***Not available***
Apollo	**URL:** http://apollo.open.ac.uk
CODE4	**URL:** http://www.csi.uottawa.ca/~doug/CODE4.html
CO4	**URL:** http://co4.inrialpes.fr/
DUET (DAML UML Enhanced Tool)	**URL:** http://grcinet.grci.com/maria/www/CodipSite/Tools/Tools.html
GKB-Editor	**URL:** http://www.ai.sri.com/~gkb/
IKARUS	**URL:** http://www.csi.uottawa.ca/~kavanagh/Ikarus/IkarusInfo.html
JOE (Java Ontology Editor)	**URL:** http://www.engr.sc.edu/research/CIT/demos/java/joe/
OilEd	**URL:** http://img.cs.man.ac.uk/oil/
OntoEdit	**URL:** http://ontoserver.aifb.uni-karlsruhe.de/ontoedit/
Ontolingua	**URL:** http://www-ksl-svc.stanford.edu:5915/
Ontological Constraints Manager (OCM)	**URL:** http://www.ecs.soton.ac.uk/~yk1/rp956.ps
Ontology Editor by Steffen Schulze-Kremer	**URL:** http://igd.rz-berlin.mpg.de/~www/prolog/oe.html
OntoSaurus	**URL:** http://www.isi.edu/isd/ontosaurus.html
Protégé-2000	**URL:** http://protege.stanford.edu
VOID	**URL:** http://www.swi.psy.uva.nl/projects/Kactus/toolkit/about.html
WebODE	**URL:** http://delicias.dia.fi.upm.es/webODE/index.html
WebOnto	**URL:** http://kmi.open.ac.uk/projects/webonto/

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Overview of ontology tools (II)

Ontology merging and integration tools

Chimaera	**URL:** http://www.ksl.stanford.edu/software/chimaera/
FCA-Merge Tool	**URL:** ***Not available.***
PROMPT	**URL:** http://protege.stanford.edu/plugins/prompt/prompt.html

Ontology-based annotation tools

OntoMarkup Annotation Tool	**URL:** http://kmi.open.ac.uk/projects/akt/
OntoMat	**URL:** http://ontobroker.semanticweb.org/annotation/ontomat/index.html
OntoAnnotate	**URL:** http://www.ontoprise.de/com/co_produ_tool2.htm
SHOE Knowledge Annotator	**URL:** http://www.cs.umd.edu/projects/plus/SHOE/KnowledgeAnnotator.html
UBOT DAML Annotation	**URL:** http://ubot.lockheedmartin.com/ubot/

Ontology learning tools

ASIUM	**URL:** http://www.lri.fr/~faure/Demonstration.UK/Presentation_Demo.html
CORPORUM-OntoBuilder	**URL:** http://ontoserver.cognit.no
LTG Text Processing Workbench	**URL:** http://www.ltg.ed.ac.uk/%7Emikheev/workbench.html
Text-To-Onto	**URL:** http://ontoserver.aifb.uni-karlsruhe.de/texttoonto/

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Ontology building tools

Criteria:

- **General Description**
- **Tools' architecture: architecture, extendibility, ontology storage, back-up**
- **Tools' interoperability: with tools, export/import from/to languages**
- **KR paradigm supported by the tool**
- **Methodological Support**
- **Tools' inference services**
- **Tools' usability**

comparative study

Tools analysed (11):

Apollo, LinkFctory, OILed, OntoEdit, Ontolingua Server, Ontosaurus, OpenKnowME, Protégé2000, SymOntoX, WebODE, WebOnto

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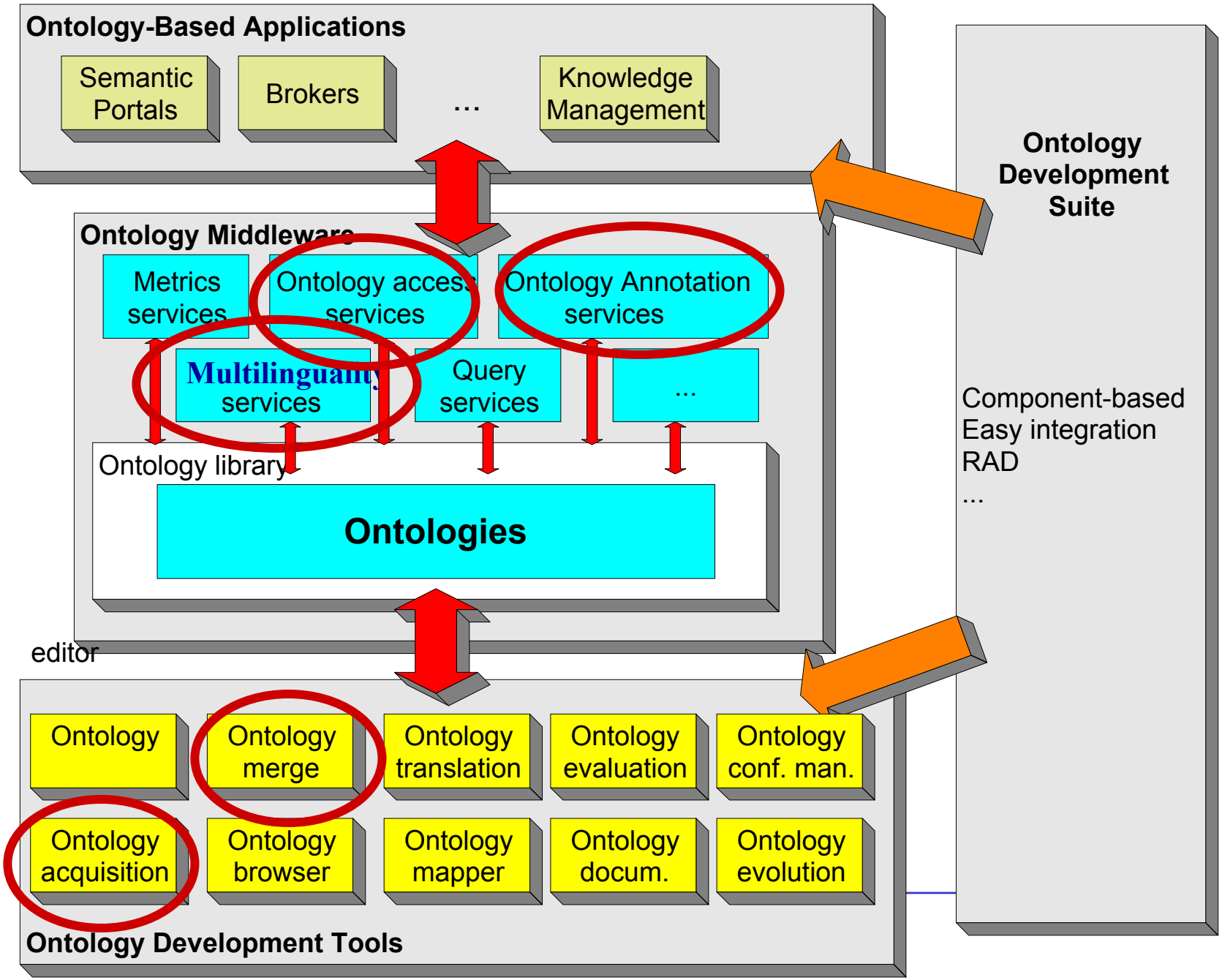
Ontology-Based Applications
Semantic Portals
Brokers
...
Knowledge Management
Ontology Development Suite
Ontology Middleware
Metrics services
Ontology access services
Ontology Annotation services
Multilinguality services
Query services
...
Ontology library
Ontologies
Component-based
Easy integration
RAD
...
editor
Ontology
Ontology merge
Ontology translation
Ontology evaluation
Ontology conf. man.
Ontology acquisition
Ontology browser
Ontology mapper
Ontology docum.
Ontology evolution
Ontology Development Tools

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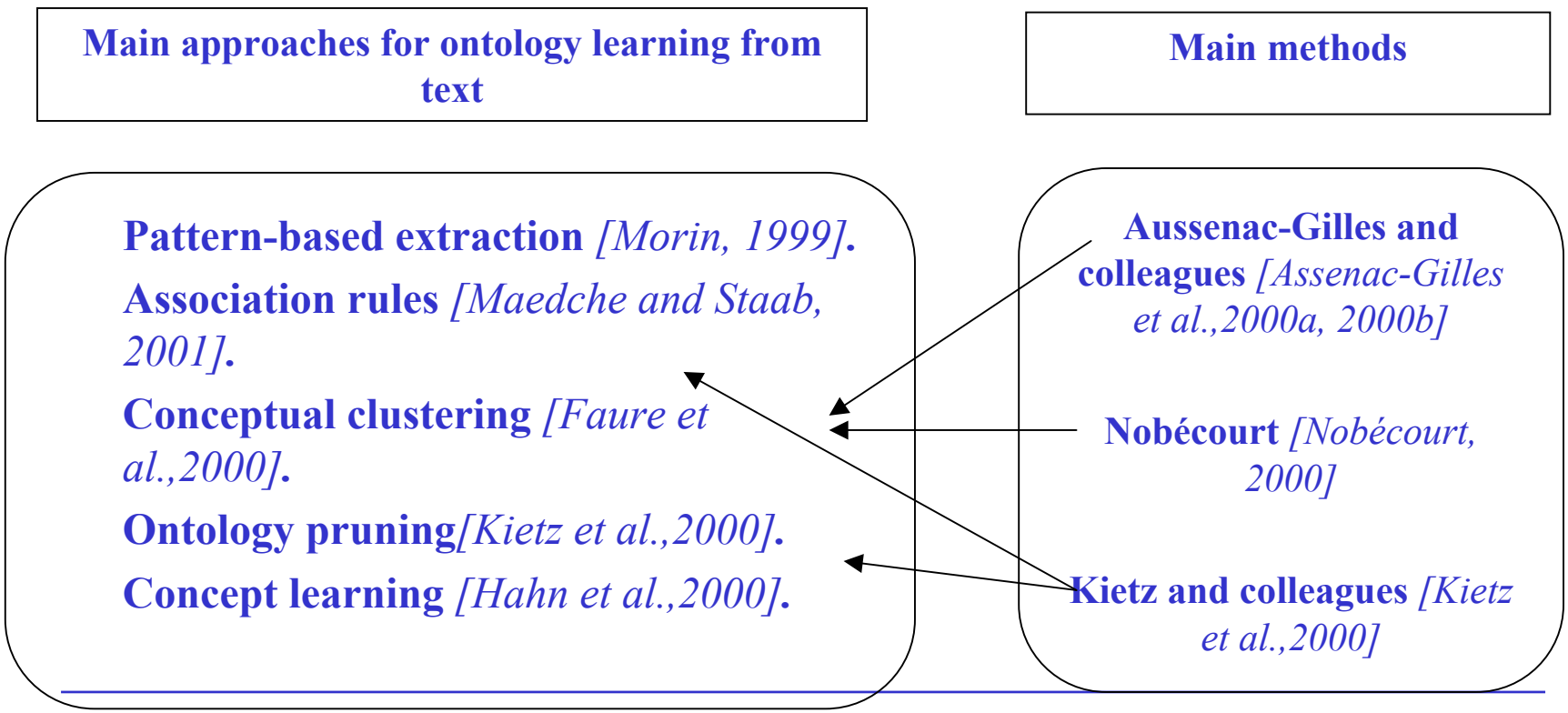
Ontology learning from text

ESPERONTO

- **Ontology extraction by applying natural language analysis techniques to text.**



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Ontology learning tools

- Are mainly based on machine learning and natural language analysis techniques.
- There are three main kinds of tools based on:
  - **Conceptual clustering:** ASIUM, Mo'K and SVETLAN'
  - **Lexical and syntactic analysis:** Corporum-Ontobuilder , LTG and Terminae.
  - **Statistical approach:** Text – To – Onto.

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Summarizes of ontology learning tools

Tool	Learning Approach	Inputs	Purpose	User intervention	Supported Method	Bibliography
ASIUM	Conceptual clustering	Natural language Texts	To built hierarchies of concepts	Validation of the results	--	[Faure and Poibeau, 2000], [Faure and Nedellec, 1999], [Faure and Nedellec, 1998]
Mo'K	Conceptual clustering	Natural language Texts	To built hierarchies of concepts	Whole process	--	[Bisson et al.,2000]
SVETLAN'	Conceptual clustering and syntactic analysis	Natural language Texts	To built hierarchies of concepts	Parameterizes the learning method	--	[Chaelandar and Grau, 2000]
CORPORUM – ONTOBUILDER	Linguistic and semantic techniques	Natural language Texts	To Extract initial ontology and refine it	Not necessary	--	http//ontoserver.cognit.no
LTG Text Processing Workbench	Linguistic and semantic techniques	Natural language Texts	To find correlations in the text	Whole process	--	[Mikheev and Finch, 1997]
TERMINAE	Linguistic analysis	Natural language Texts	To built an ontology	Whole process	Aussenac – Gilles and colleagues and Nobecourt	[Biébow et al.,1999]
Text-To-Onto	Statistical approach, pruning methods and association rules	Natural language texts, legacy ontology	To built an ontology	Whole process	Kietz and colleagues.	[Maedche and Staab, 2001]

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Ontology Learning Conclusions

- There exists no detailed methodology for ontology learning process.
- The existing methods are mainly based on natural language analysis and use a corpus that guide the process.
- Kietz and colleagues method uses a previous ontology.
- All methods require the participation of an ontologist.
- They mainly discover concepts and taxonomic knowledge

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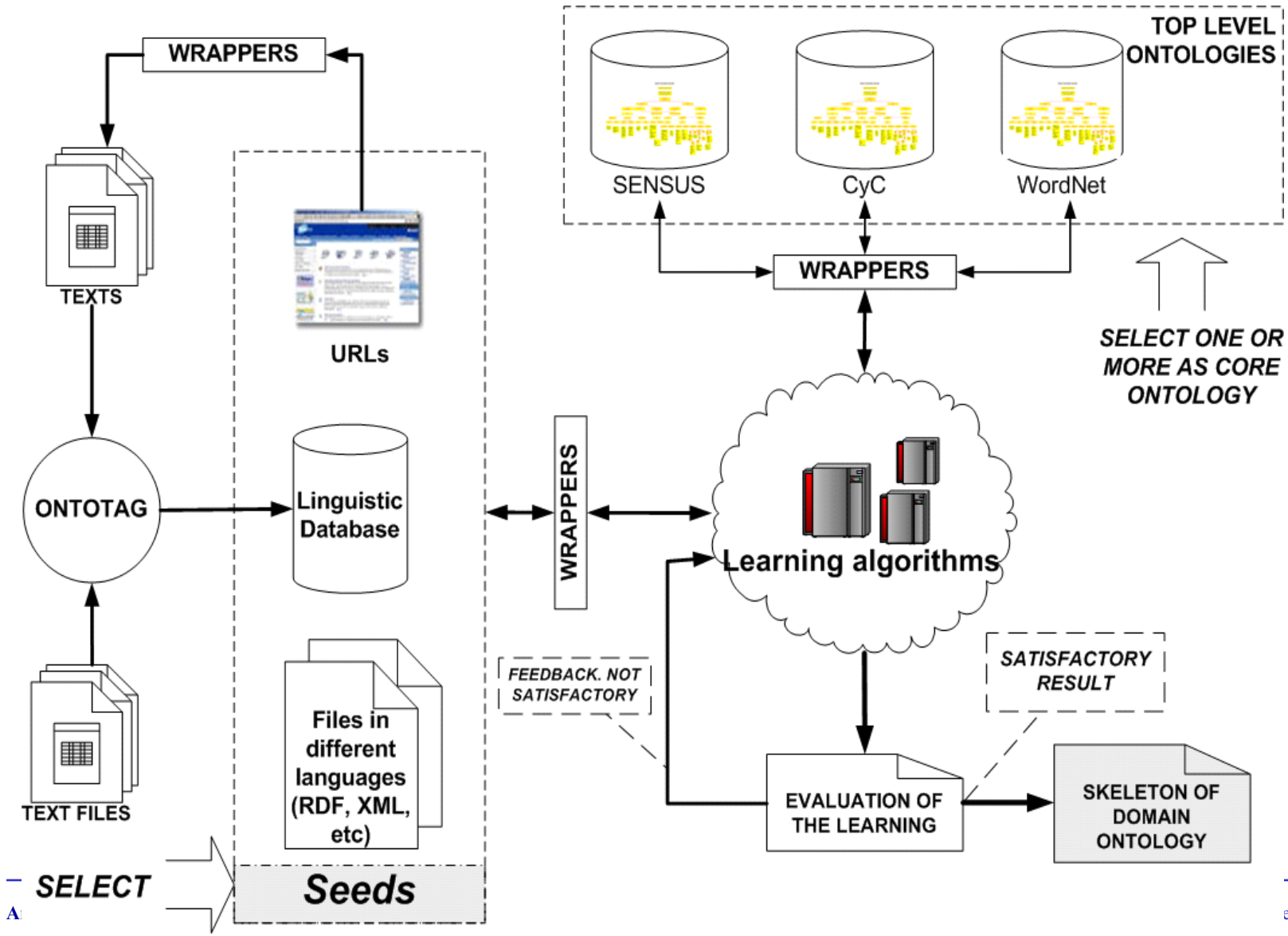
WRAPPERS
TOP LEVEL ONTOLOGIES
SENSUS
CyC
WordNet
TEXTS
URLs
WRAPPERS
SELECT ONE OR MORE AS CORE ONTOLOGY
ONTOTAG
Linguistic Database
WRAPPERS
Learning algorithms
FEEDBACK. NOT SATISFACTORY
SATISFACTORY RESULT
TEXT FILES
Files in different languages (RDF, XML, etc)
EVALUATION OF THE LEARNING
SKELETON OF DOMAIN ONTOLOGY
SELECT
Seeds

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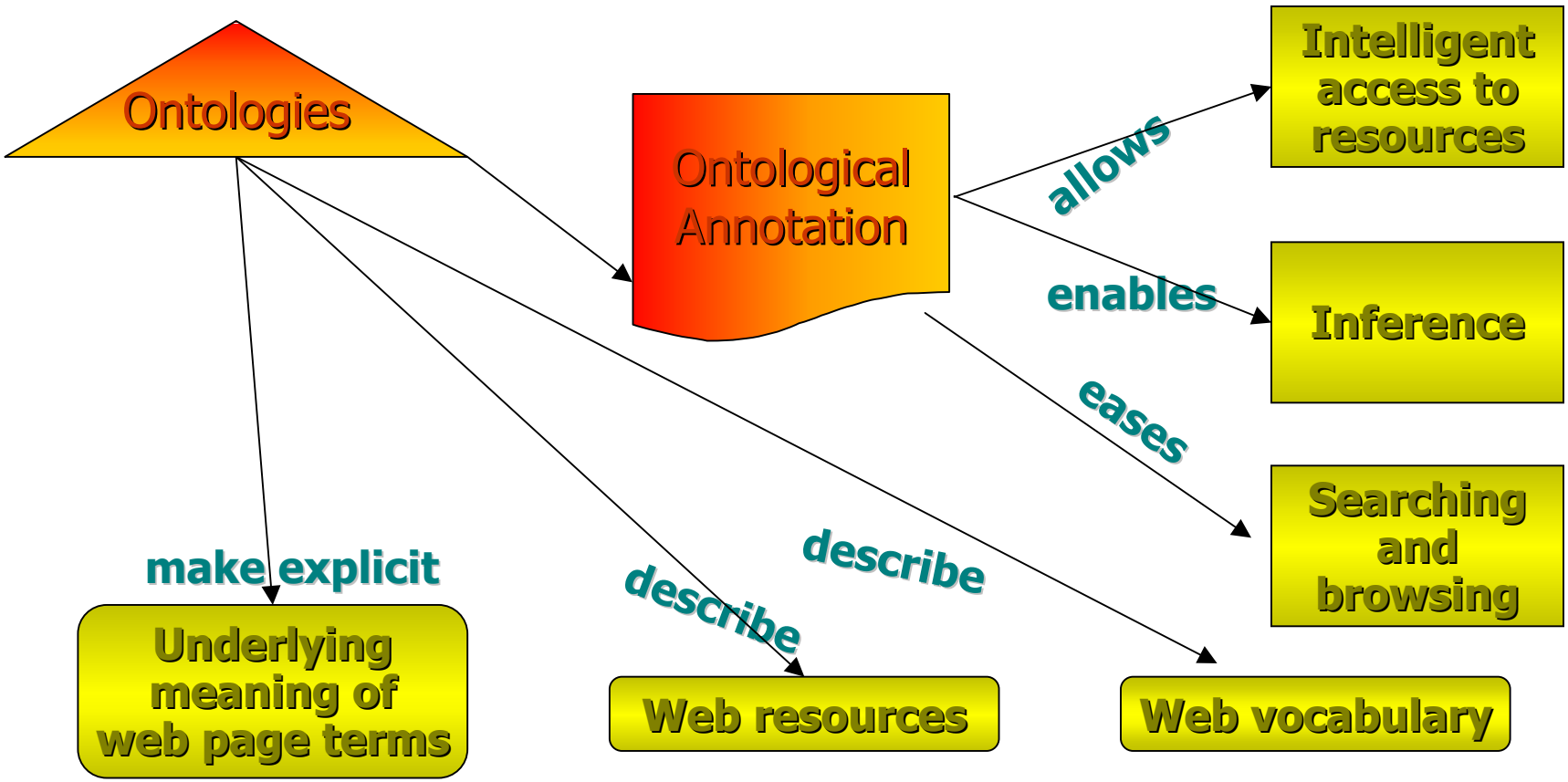
Ontologies and Semantic Web Annotations



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Ontology-based Annotation Tools

	AeroDAML (web version)	COHSE	MnM	OntoAnnotate	OntoMat-Annotizer	Shoe Annotator
Ontology Source	Predefined	Ontology server – may be local	WebOnto server – may be local	Local file Ontobroker	Local file URL	Local file URL
Ontology Language	DAML	OIL DAML+OIL	OCML	F-Logic RDF(S)	DAML+OIL F-Logic, RDF(S)	SHOE
Populated Ontology Destination	Not applicable	Not applicable	Local file, WebOnto server	Local file Ontobroker	Local file	Not applicable
Ontology elements	Not applicable	Concepts Attributes	Concepts Attributes	Classes Instances Attributes Relations	Classes Instances Attributes Relations	Concepts Relations Claims
Interoperability	Not applicable	Mozilla web browser Annotea	WebOnto	OntoBroker	OntoBroker	Exposé, SHOE Search, Semantic Search
Document source	URL	Local file Web	Local file Web	Local file Web	Local file Web	Local file Web
Markup Language	DAML	DAML+OIL	XML	HTML-A	DAML+OIL	SHOE
Marked-up document destination	Web page	Local file Annotation server	Local file	Local file	Local file	Local file
Automation	Yes (see description above)	Yes	Semi-automatic extraction after training phase	Partial (see description above)	Not yet available	No
Collaboration	No	Yes	No	Via Ontobroker	Via Ontobroker	No
Usability	Extremely simple to use	Good	Good	Good	Good	Good

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Conclusions

- There seems to be a growing consensus that DAML+OIL / OWL should form the basis both for ontologies and markup.
- Most of the tools are written in Java.
- There is a trend towards flexible plug-in architectures.
- These tools will need to work with any new Semantic Web standards (such as W3C's Ontology Web Language).
- No relation with linguistic annotations

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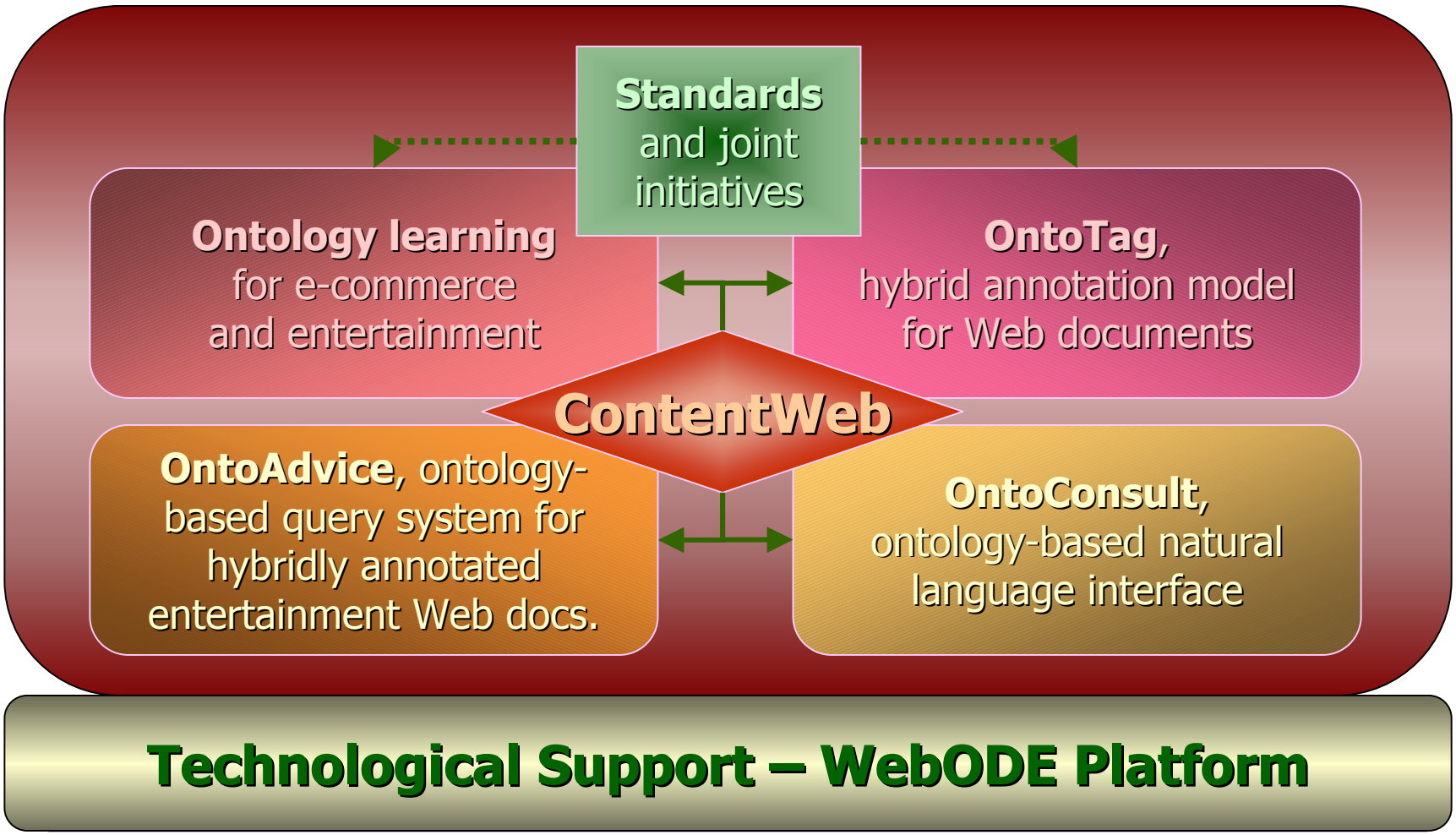
OntoTag in Context: ContentWeb (TIC2001-2745)



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Questions?

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