

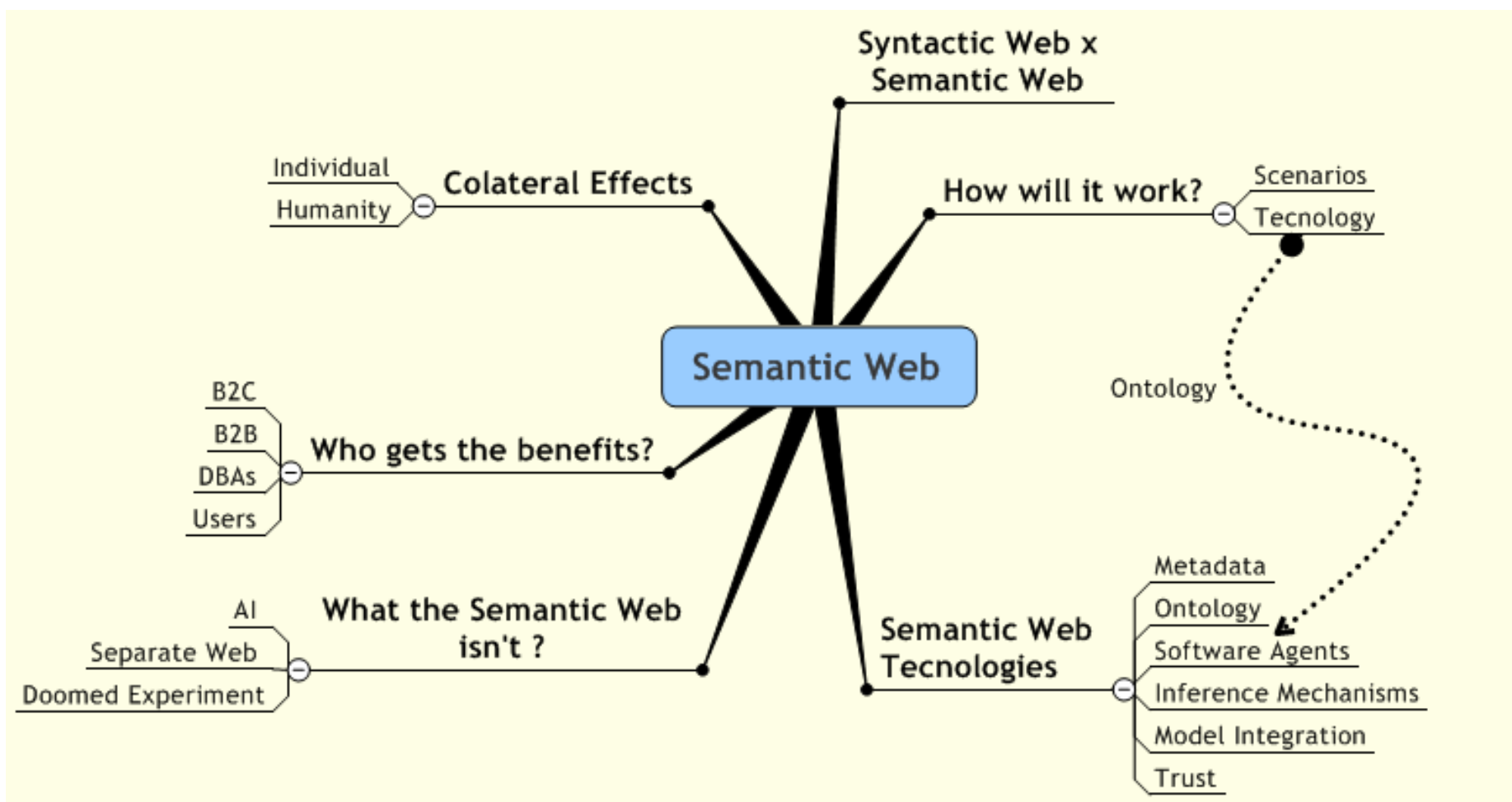


Semantic Technologies

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Organization of the talk



The Web today

- The syntactic web
 - Developed as an information exchange medium for PEOPLE
 - Computers **display** information whereas **interpretation** is left for humans.

- 8 billion of pages
 - Web search engines
 - No “result interpretation” engines

Information for Human Consumption



C:\Karin on Bola\livro\web semantica\capitulos\cap1\Figuras\figura1_1.htm - Microsoft Internet Explorer - [Working Offline]

File Edit View Favorites Tools Help

Address www.inf.puc-rio.br/~karin Go Google

Links C&L - Editor de Cenários e Lexicos Endymion MailMan FRODO RDFSViz Google SBC SemanticSearch

RE Engenharia de Requisitos

Requirements Engineering

KARIN KOOGAN BREITMAN

Dr. Karin Breitman received her DSc. from the Departamento de Informática da Pontifícia Universidade Católica do Rio de Janeiro, where she is currently teaching and continues to work in her research. Her interests are software requirements engineering, scenario based software process and software evolution. She was part of the Program Committee of the last two editions of the International Conference on Requirements Engineering (ICRE) and the workshop de Engenharia de Requisitos (WER) since 1998. Dr. Breitman is currently serving as the South American publicity chair for the RE'03. She belongs to ACM, IEEE and the Brazilian Computing Society (SBC), where she is currently serving in the board of directors .

Cursos

[Engenharia : Curso deEstruturas de Dados \(INF 1620\)](#)

[Pós Graduação: Course de Engenharia de Requisitos \(INF 2044 & INF 1809\)](#)

[Engenharia : Curso dePrincípios de Engenharia de Software \(INF 1629\)](#)

Algumas Publicações

start Figuras library 20050109.d... figura1_1.ht... C:\Karin on ... PT 11:19 PM

How a machine sees this page



Semantic Web

- “The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.”

Tim Berners-Lee, Hendler e Lassila

Scenario I - Search for “organ” (musical instrument)

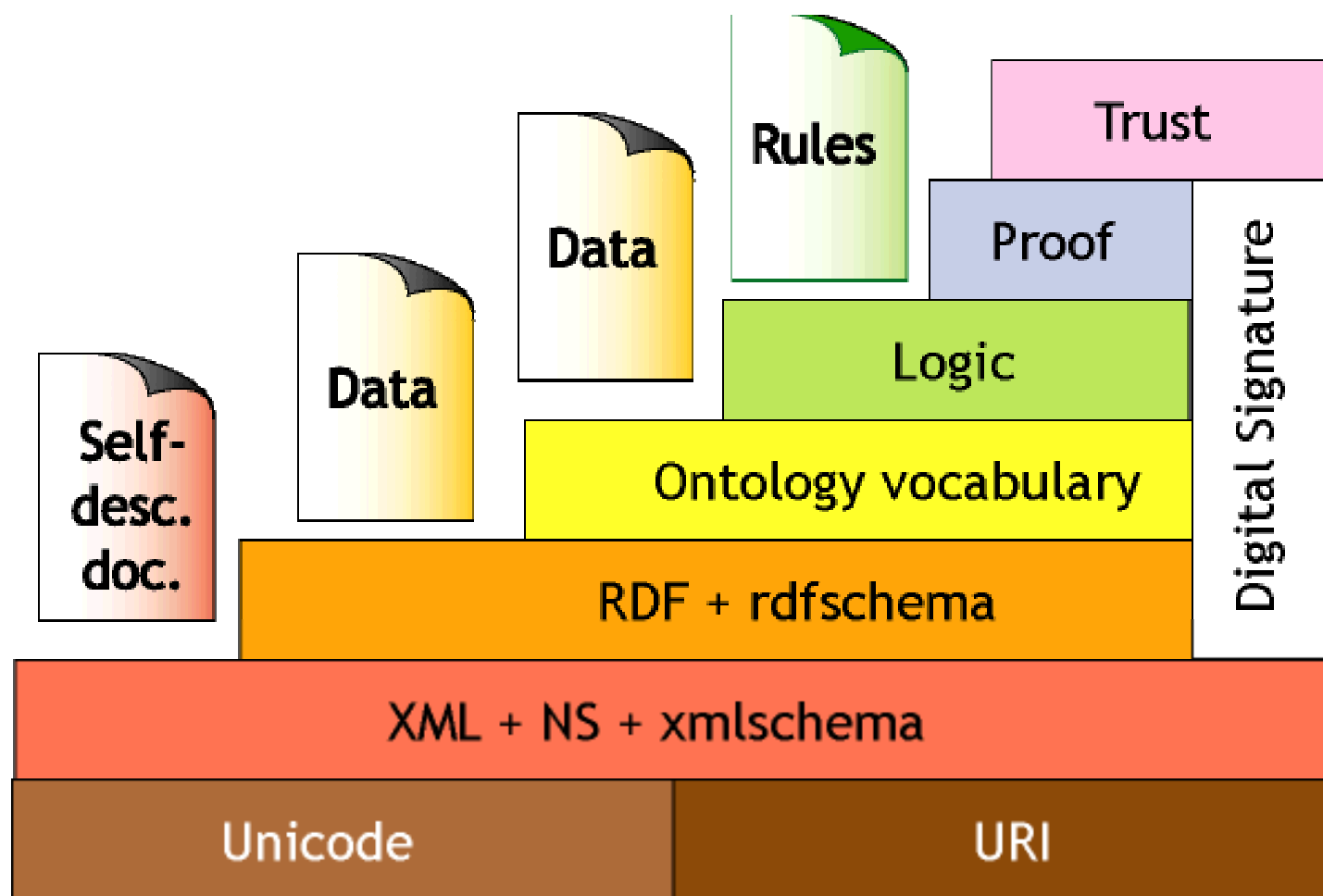
- [The Official US Government Web site for Organ and Tissue Donation ...](#)
Official Organ Donation and Transplantation Web site of the US Department of Health and Human Services. ... Each day, about 70 people receive an organ transplant. ...
- [United Network for Organ Sharing: Organ Donation and ...](#)
UNOS oversees the national database of clinical transplant information and operates the computerized organ sharing system, matching donated organs to patients ...
- [Allen Organ Company - The Largest Builder of Church Organs in the ...](#)
... Allen Organ, Allen organs, Allen Organ Company, Allen, Ensemble, Quantum, Renaissance, Protege, Sebastian, Heritage, Acoustic Portrait, Quad Suite, Expanded ...
- [Organ Historical Society](#)
www.organsociety.org/ -
- [Coalition on Donation -- Donate Life -- Homepage](#)
... Send an e-postcard. Get the Facts Check out organ donation facts and transplantation statistics; review stories of hope and visit related links. ...
- [TransWeb: All About Transplantation and Donation](#)
Questions and answers, myths, and other information about organ transplants and donation.
- [Organ History](#)
The Pipe Organ, a description in two parts: "The organ and how it works" and "The History of the Organ"
- [Organ System Pathology](#)
Organ System Pathology Images. Return to the WebPath main menu. Sections of the WebPath images are available for viewing below by organ system. ...
- [Organ Pipe Cactus National Monument \(National Park Service\)](#)
... park conditions. more » Organ Pipe Cactus National Monument celebrates the life and landscape of the Sonoran Desert. Here, in this ...

Scenario II - Scheduling medical appointment

- Lucy's mom needs physical therapy sessions:
 - Lucy is driving her, needs to be near her place of work
 - Should be a good professional
 - Should belong to her medical plan
 - Should have openings compatible with Lucy's agenda

Simplification of the scenario that appears in: Berners-Lee, T.; Lassila, O. Hendler, J. – The Semantic Web. Scientific American, 284 (5), 2001, pp.34-43

Semantic Web Architecture (TBL)



Semantic Web

- Universality
 - hypertext link “anything can link to anything”
 - Web technology must not discriminate:
 - between the scribbled draft and the polished, performance,
 - between commercial and academic information,
 - among cultures.
- Decentralized
 - compromise: throw away the ideal of total consistency
 - allow exponential growth - unverified

How to get there?

- Metadata
- Ontology
- Agents
- Inference Mechanisms
- Model Integration
- Trust

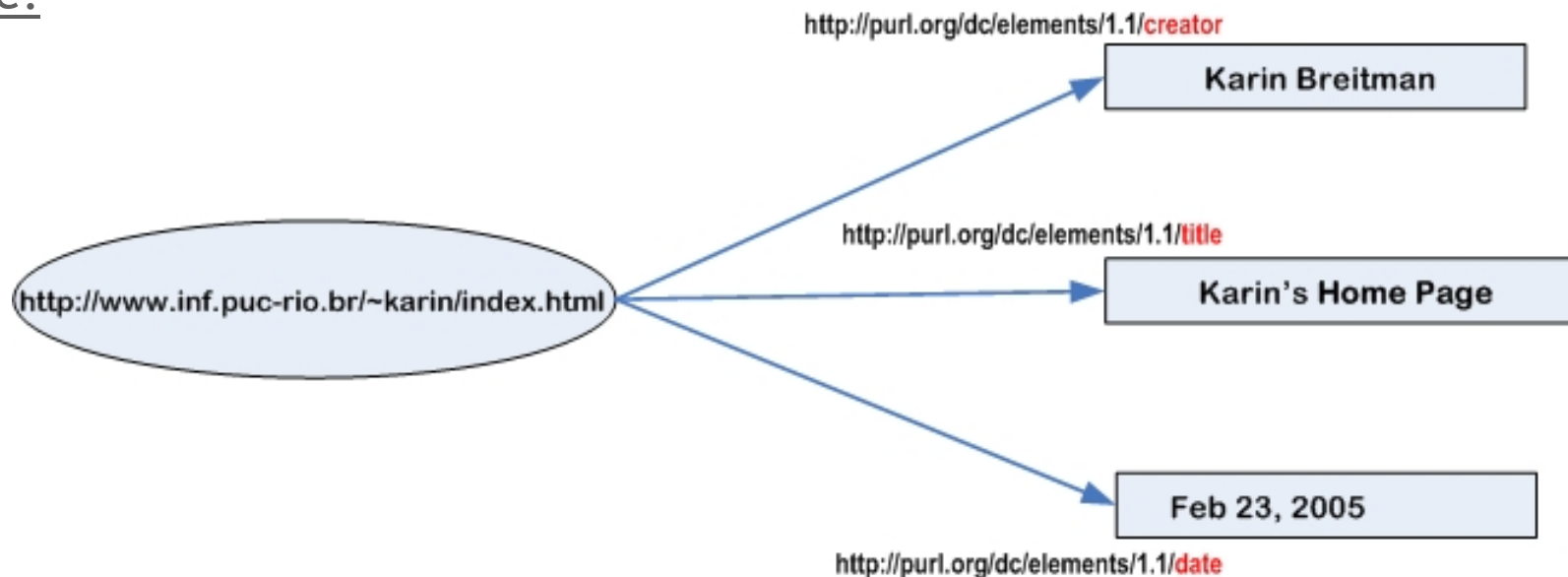
Metadata

- Metadata- “data about data” - International Federation of Library Associations
- WWW Conference - agreement on semantics for internet resources
- Metadata Workshop - Dublin Core (subject, title, author, publisher, other agent, date, type, form, identifier....)
- Warwick Framework
- RDF
 - Extends the Warwick Framework
 - Defines an unified data model and syntax

RDF Model

Dublin Core:

- Subject
- Title**
- Creator**
- Description
- Publisher
- Contributor
- Date**
- Type
- Format
- Identifier
- Relation
- Source
- Language
- Coverage
- Rights



Subject (resource)	Predicate(property)	Object (value)
http://www.inf.puc-rio.br/~karin/index.html	http://purl.org/dc/elements/1.1/creator	"Karin Breitman"
http://www.inf.puc-rio.br/~karin/index.html	http://purl.org/dc/elements/1.1/title	"Karin's Home Page"
http://www.inf.puc-rio.br/~karin/index.html	http://purl.org/dc/elements/1.1/date	"Feb 23, 2005"

Metadata

- Metadata alone is not enough!
- Communication
 - Polisemy, ambiguity and synonyms
 - Tacit Knowledge

Polisemy - organ

- The noun “organ” has 5 senses in WordNet.
 - 1. organ -- (a fully differentiated structural and functional unit in an animal that is specialized for some particular function)
 - 2. organ -- (a government agency or instrument devoted to the performance of some specific function; "The Census Bureau is an organ of the Commerce Department")
 - 3. electric organ, electronic organ, Hammond organ, organ -- ((music) an electronic simulation of a pipe organ)
 - 4. organ -- (a periodical that is published by a special interest group; "the organ of the communist party")
 - 5. organ, pipe organ -- (wind instrument whose sound is produced by means of pipes arranged in sets supplied with air from a bellows and controlled from a large complex musical keyboard)
 - 6. harmonium, organ, reed organ -- (a free-reed instrument in which air is forced through the reeds by bellows)

Ambiguity

- Increases the range of possible interpretations
- Different cultures may use the same expression with different meanings
- Appears as if there is understanding
 - Draw the curtains
 - Put the lights out
 - Dress the chicken

Synonyms

- Common in Natural Language
- Have great impact on word-based searches:
 - If we try harmonium instead of organ:
 - [Chandra and David's Indian Harmonium Page - Hand Pumped Indian ...](#)
... HARMONIUM. by David Courtney, Ph.D. ... Parts of Harmonium. There are a number of parts of the harmonium, here are some of the main ones: Portable harmonium. Body. ...
 - [Harmonium sur le web](#) - [[Translate this page](#)]
Quoi de neuf? 13 septembre 2004 Serge Fiori autorise un hommage à Harmonium. Le groupe Premier Ciel est fier d'annoncer avoir obtenu ...
 - [The harmonium - Indian classical instrument](#)
The harmonium is a Western instrument adapted for Indian music. It is mainly used in the accompagnement of Khyal, Thumri and Qawwali. ...
 - [Amazon.com: Music: Harmonium \[ENHANCED\]](#)
... Yes, Carlton is maturing and Harmonium brings her closer to where she's going, but she's still got a ways to go. ... Harmonium is beautiful. ...

Tacit Knowledge

- Too trivial to mention
- Embodied knowledge
- Always present in human conversation
- Must be made explicit to allow machine interaction

→ more expressive representations

What's needed

- More expressive representations that:
 - Explicit domain concepts, axioms, properties and relationships
 - Make domain assumptions explicit
 - Share common understanding of the structure of information among people and machines (software agents)
 - Separate domain knowledge from operational knowledge

Ontology

- *Subject: study of the categories of things that exist or may exist in some domain"*
- *Product: "catalog of the types of things that are assumed to exist in a domain of interest D*

ontos (being) + *logos* (word)

- Plato - metaphysics
- Aristotle - 10 categories κατηγορια
- Philosophy - study of being X study of various kinds of beings

Porphyry's Tree

Supreme genus:

Differentiae:

Subordinate genera:

Differentiae:

Subordinate genera:

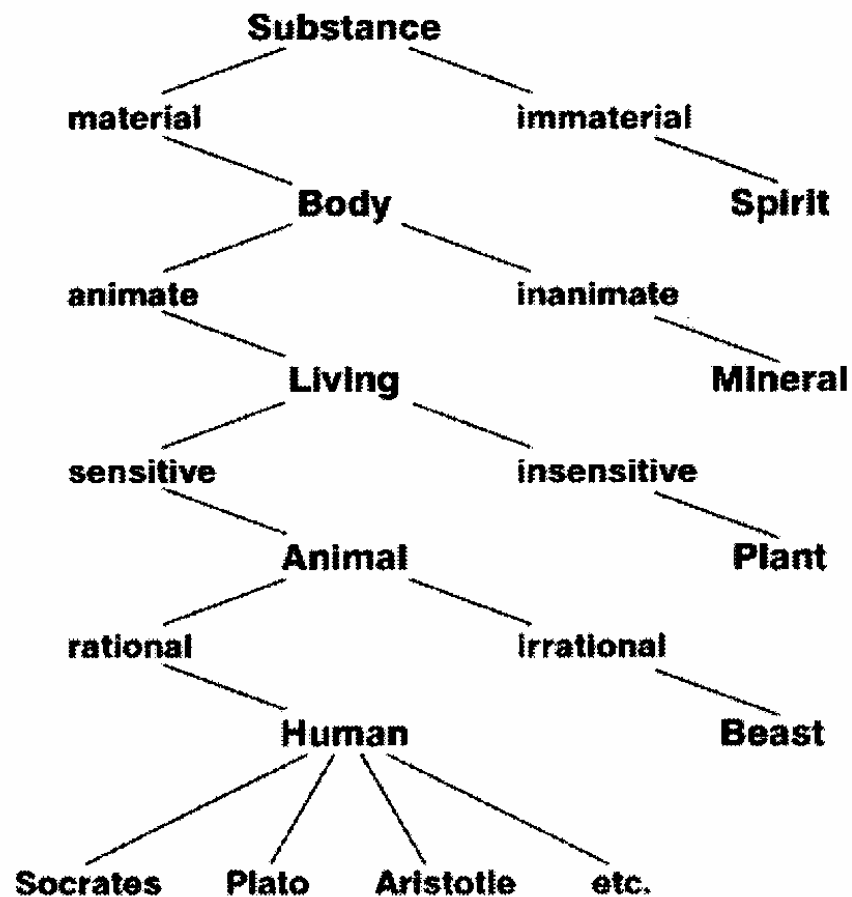
Differentiae:

Proximate genera:



Differentiae:

Species:

Individuals:



Ontology x ontology [Guarino98]

- Philosophy
 - Discipline  Ontology
- Computer Science
 - Artifact  ontology

Approaches

- AI - Knowledge Engineering
 - Domain mapping, creation of large knowledge bases, mapping human knowledge
 - Upper Ontologies
 - Built by experts

- Semantic Web
 - Specific applications
 - Built by non experts

Upper ontologies

- Cyc upper ontology
 - Knowledge base with around 3000 terms
(“capturing the most general concepts of human consensus reality”)
- SUMO
- John Sowa’s
- WordNet
 - On line lexical reference with over 42.000 links to words
(nouns, verb, adjectives and adverbs)
(“whose design is inspired by current psycholinguistic theories of human lexical memory”)

Criticism

- There is no consensus on a über upper ontology
 - Open questions
 - 3D Versus 4D
 - As software engineers:
 - Little chance of making a real contribution
 - Tackle practical problems
- Ontologies are not substitutes for human categorization
 - Wittgenstein
 - Rosch

Semantic Web

- Application rather than upper ontologies:
- More restricted
 - Contextualized information
 - Relevant to the application
- Narrower Goals
- Smaller

Definition [Tim Berners-Lee]

“an ontology is a document or file that formally defines the relationship among terms”

- Maedche’s definition:

$O := \{C, \mathcal{R}, \mathcal{H}^C, rel, \mathcal{A}^O\}$ consisting of:

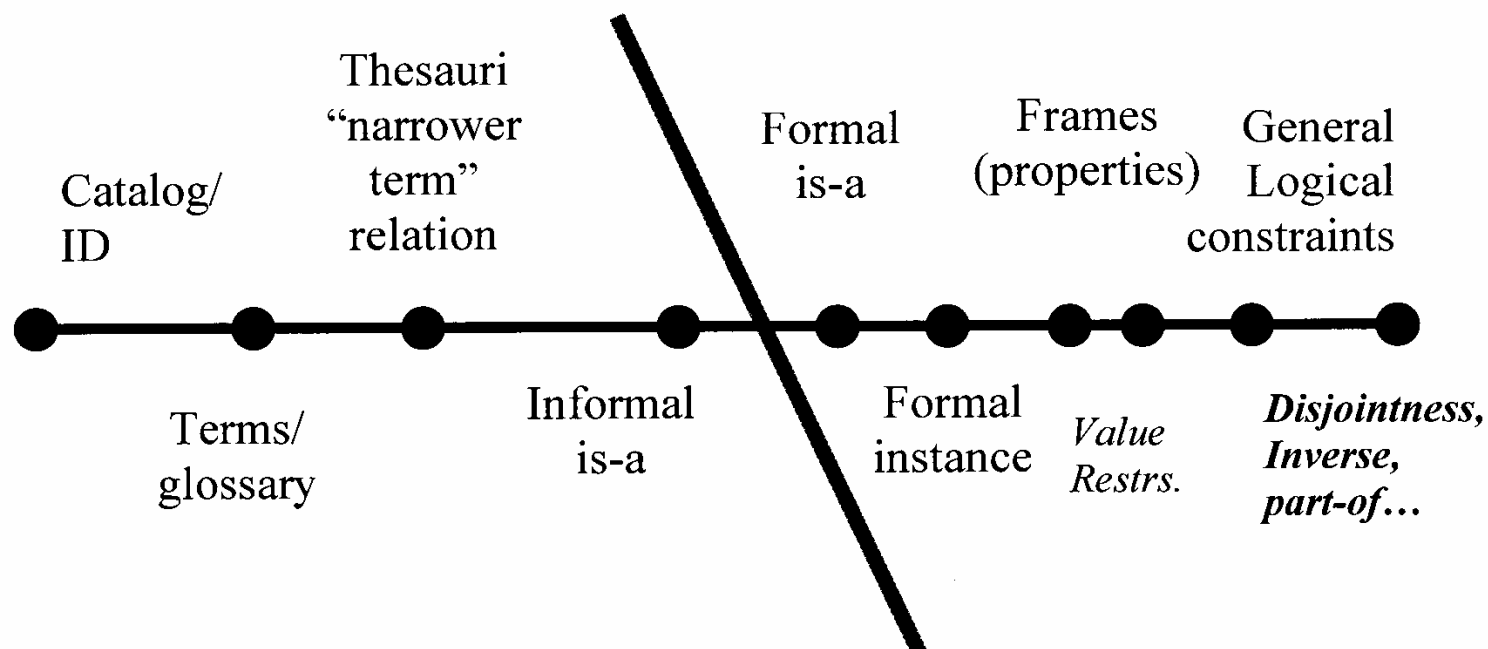
§ Two disjoint sets, C (concepts) and \mathcal{R} (relations)

§ A concept hierarchy, $\mathcal{H}^C: \mathcal{H}^C$ is a directed relation $\mathcal{H}^C \subseteq C \times C$ which is called concept hierarchy or taxonomy. $\mathcal{H}^C(C_1, C_2)$ means C_1 is a subconcept of C_2

§ A function $rel: \mathcal{R} \rightarrow C \times C$ that relates the concepts non taxonomically

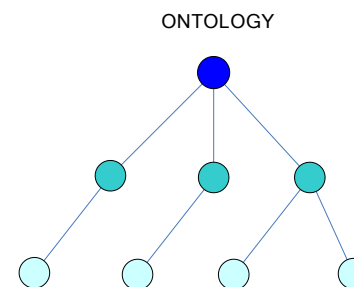
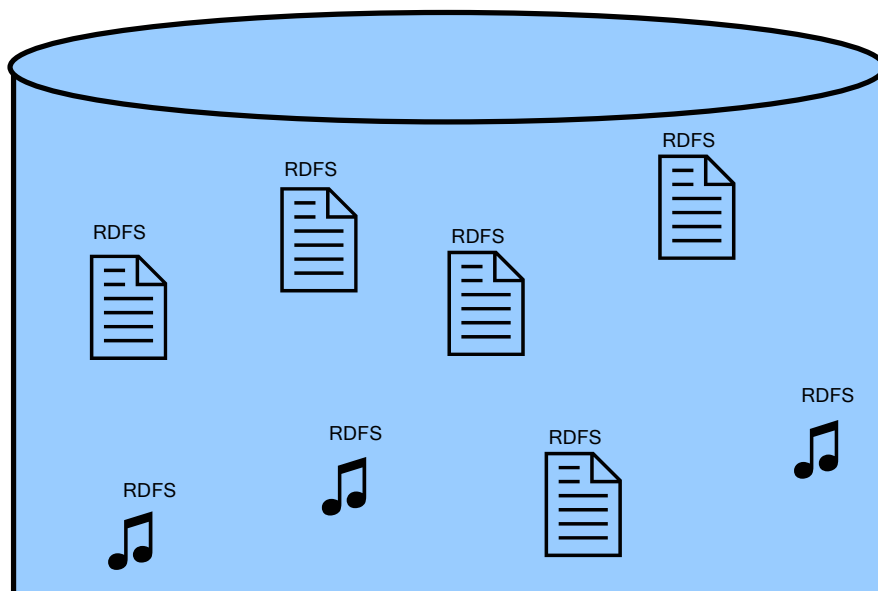
§ A set of ontology axioms \mathcal{A}^O , expressed in appropriate logical language.

Types of ontology



Ontology versus Metadata

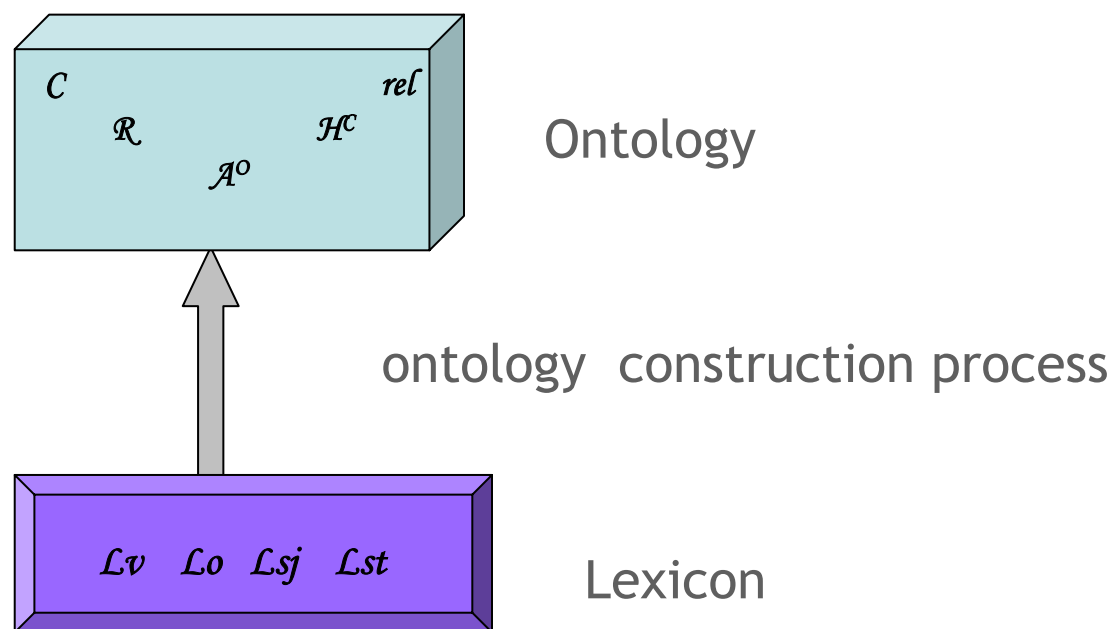
- Combine resources with metadata,
- Use ontology(ies) to explicit concepts and relationships.



Ontology Construction

- Uschold
- Methontology
- Tove
- McGuinness & Noy (Ontology 101)
- Lexicon Based Construction Process:
 - Non experts
 - Mature process
 - Validated in real life projects
 - Lightweight
 - Focus in the “language of the problem”
 - Makes explicit the separation between domain specific terms and those from the minimal vocabulary

Ontology Construction



Language Extended Lexicon (LEL)

- A different type of lexicon.
- Oriented towards the language of the problem.
- Using both denotation and connotation.
- Foundations:
 - The Theory of Semiotics (Eco): the idea of symbols and their contextualization.
 - Carnap's Observational Language (Vienna School): the idea that terms in a language are anchored on observational phenomena.
 - Sociology: the idea that language is a reflection of culture.
 - Domain Languages (Neighbors): high level reuse is achieved by specific languages, similar to the concept of little languages (Bentley).
 - Social-Aspects of Computing (Kling): the interplay between social actors and computers systems.
 - Hyperties (Shneiderman): one of the first implementations of the hypertext.

Example - Lexicon Entry

Requester

Notion:

- person who invites attendees to a meeting.
- may be a participant.

Behavioral Response:

- defines the objective of the meeting, the subjects to be discussed, the attendee list and materials.
- records the objective and the attendee list in the agenda.
- organizes the meeting.
- decides changes in the meeting requirements.

Types of entry

	Notion	BehavioralResponse
Subject	Who is the subject?	Which actions are performed?
Verb	Who performs, when it happens e what procedures are involved.	What are the impacts of the action in the environment (other actions that also occur) and what are the resulting states.
Object	Define the object and identify other objects with which it relates to.	Actions that can be applied to the object.
State	What it means and which actions gave rise to this state.	Identify other states and actions that may happen departing from the state object of the description.

Tool Support



The screenshot shows a web browser window titled "C&L - Cenários e Léxico - Microsoft Internet Explorer". The address bar shows the URL "http://139.82.24.189/cel/aplicacao/index.php". The page header includes a logo for "léxico & cenários" and navigation links: "Administrador", "Projeto: *ontology tutorial", "Adicionar Cenário", "Adicionar Léxico", "Info", "Adicionar Projeto", "Remover F", "Alterar Cadastro", and "Sair".

The main content area is titled "Informações sobre o léxico" and displays the following information:

- Nome:** fast-food restaurant
- Noção:** it is a restaurant where customers places an **order**, pay and receive the **order** standing in front of **cashier**.
- Impacto:** **customer** buys food at fast-food restaurant. **employee** works at fast-food restaurant.
- Sinônimo:** fast-food

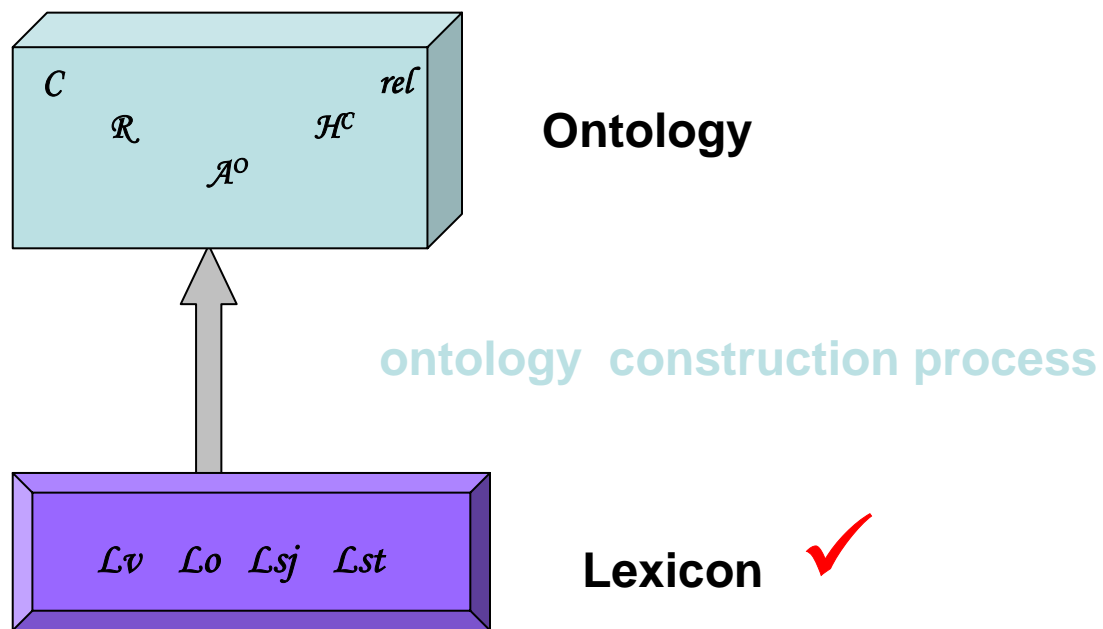
Below this information are two buttons: "Alterar Léxico" and "Remover Léxico".

The next section is titled "Cenários e termos do léxico que referenciam este termo". It has two tabs: "Cenários" and "Léxicos". Under the "Léxicos" tab, the following terms are listed:

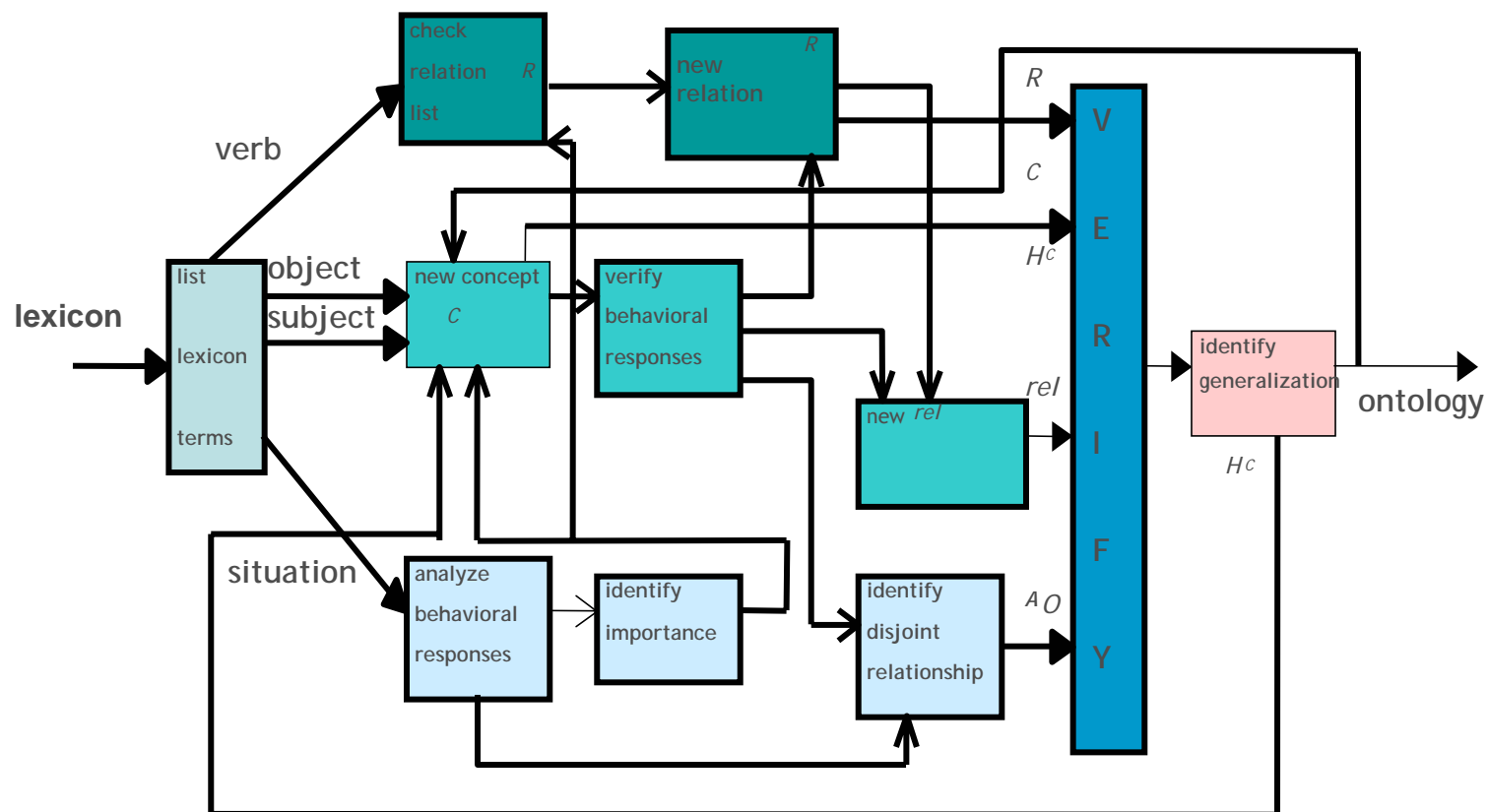
- menu option
- employee
- customer
- attendant

At the bottom of the page, there is a link: "Veja o código fonte".

Lexicon to ontology



Process



[Breitman04] - Breitman, K.K.; Leite, J.C.S.P - Lexicon Based Ontology Construction - Lecture Notes in Computer Science 2940- Editors: Carlos Lucena, Alessandro Garcia, Alexander Romanovsky, et al. - ISBN: 3-540-21182-9 - Springer-Verlag Heidelberg, February 2004, pp.19-34.

Prediction

- (The Semantic Web will be composed of a) "*great number of small ontological components consisting largely of pointers to each other*" [Hendler01].
- As opposed to general, upper ontologies such as CYC and Wordnet

The problem is not ontology engineering

- A Model by any other name....
 - Model construction - ER, OO, Kaos, i*, ...
 - Difficulty is in the “good model”
 - Corresponds to reality
 - Good decomposition
 - Adequate terminology
 - Explicit important concepts
 - Validated with users ...
 - Focus on generalization (subsumption)
- Implementation is straightforward
 - DAML+OIL - OWL

Semantic interoperability

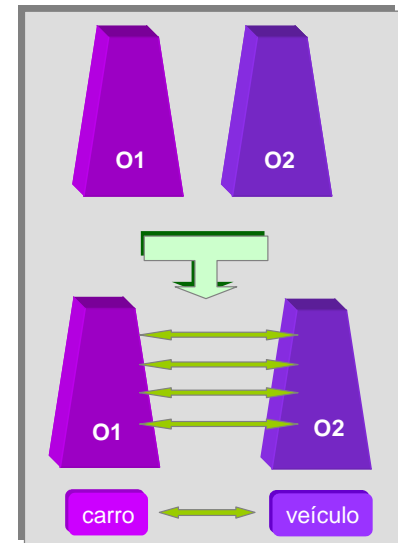
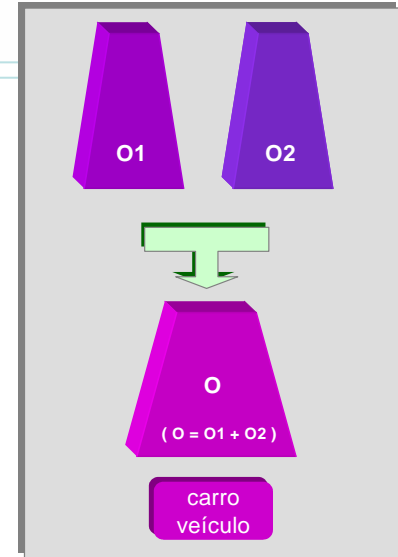
- Bottleneck: Different ontologies must speak
 - 8 Billion pages - cannot expect everyone to commit to the same ontology
 - Give opportunities for “strange agents” to communicate:
 - Different implementations
 - Open Environment
 - Web Services paradigm

Existing approaches

- Automatic, semi-automatic or, even, manual.
- Ontology design community- syntactic matches, use of dictionaries, transformation:
 - Ontomorph
 - Chimaera
 - Protégé - Prompt
 - CATO
 - Bailin & Truszkowski

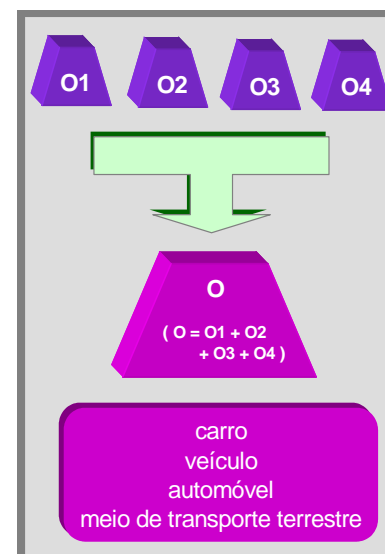
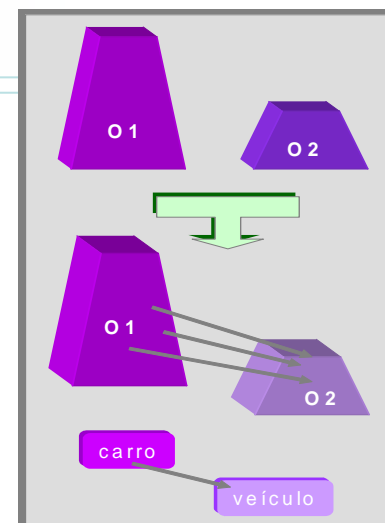
Ontology Interoperability

- **Merge:** results in a unique ontology that contains all the terms from merged original ontologies, without indication of their former origin.
 - Often, the ontologies cover similar or overlapping domains.
- **Mapping:** results in a formal structure containing expressions that link concepts from one conceptual model to another.



Ontology Interoperability

- Alignment: results in separate ontologies with links between them. The links allow ontologies to share terms.
 - Often, the ontologies cover complementary domains.
- Integration: results in a unique ontology created by assemblage, extension, specialization or adaptation of ontologies from different subject areas -> It is possible to identify provenance.



CATO:an implementation

01

```

- <ontoInXML>
  <Classe>InConference</Classe>
  <Classe>CMU_Publication_Entry</Classe>
  <Classe>BibtexEntry</Classe>
- <Classe>
  Bibtex_Publication_Type
  <subClasse>Proceedings</subClasse>
  <subClasse>MastersThesis</subClasse>
  <subClasse>PhdThesis</subClasse>
  <subClasse>InCollection</subClasse>
  <subClasse>TechReport</subClasse>
  <subClasse>misc</subClasse>
  <subClasse>InBook</subClasse>
  <subClasse>Book</subClasse>
  <subClasse>unpublished</subClasse>
  <subClasse>Article</subClasse>
  <subClasse>Manual</subClasse>
  <subClasse>Booklet</subClasse>
  </Classe>
  <Classe>Bibtex_Entry</Classe>
  <Classe>CMU_Publication_Entry</Classe>
  <Classe>Center</Classe>
  <Classe>Unpublished</Classe>
  <Classe>Misc</Classe>
  <Classe>Project</Classe>
  <Classe>Conference</Classe>
  <Classe>Literal</Classe>
  <Classe>Lab</Classe>
</ontoInXML>

```

02

```

- <subClasse>
Publication
  <subClasse>Proceedings</subClasse>
  <subClasse>Regulation</subClasse>
+ <subClasse>
  <subClasse>Advertisement</subClasse>
  <subClasse>Specification</subClasse>
  <subClasse>Book</subClasse>
+ <subClasse>
  <subClasse>Manual</subClasse>
  <subClasse>Dictionary</subClasse>
- <subClasse>
  Thesis
  <subClasse>DoctoralThesis</subClasse>
  <subClasse>MastersThesis</subClasse>
  </subClasse>
  <subClasse>Editorial</subClasse>
  <subClasse>TechnicalReport</subClasse>
  </subClasse>
+ <subClasse>
  <subClasse>Lecture</subClasse>
  <subClasse>Index</subClasse>
  <subClasse>Preprint</subClasse>
  </subClasse>
- <Classe>
  Subject
  <subClasse>Universal</subClasse>
- <subClasse>
  Individual
  <subClasse>Schedule</subClasse>
+ <subClasse>
+ <subClasse>
- <subClasse>
  Event
  <subClasse>Conference</subClasse>
- <subClasse>

```

Result

- Part of the Aligned Ontology:

```

- <owl:Class rdf:about="file:firstOnto.owl#Book">
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#Manual" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#Proceedings" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#InConference" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#Conference" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#MastersThesis" />
</owl:disjointWith>
  <owl:disjointWith rdf:resource="file:firstOnto.owl#TechReport" />
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#InBook" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#PhdThesis" />
</owl:disjointWith>
- <owl:disjointWith>
  <owl:Class rdf:about="file:firstOnto.owl#Misc" />
</owl:disjointWith>
  <rdfs:subClassOf rdf:resource="file:firstOnto.owl#Bibtex_Publication_Type" />
- <owl:equivalentClass>
  <owl:Class rdf:about="file:secondOnto.owl#Book" /> } ← Added Information
</owl:equivalentClass>
  <owl:disjointWith rdf:resource="file:firstOnto.owl#Unpublished" />
  <owl:disjointWith rdf:resource="file:firstOnto.owl#Booklet" />
</owl:Class>

```

Agents and the Semantic Web

- Rely on Semantic Web technologies to better function in Open Environments
- Autonomous behavior
- Interaction is only possible if software agents can communicate
 - Metadata
 - Ontology

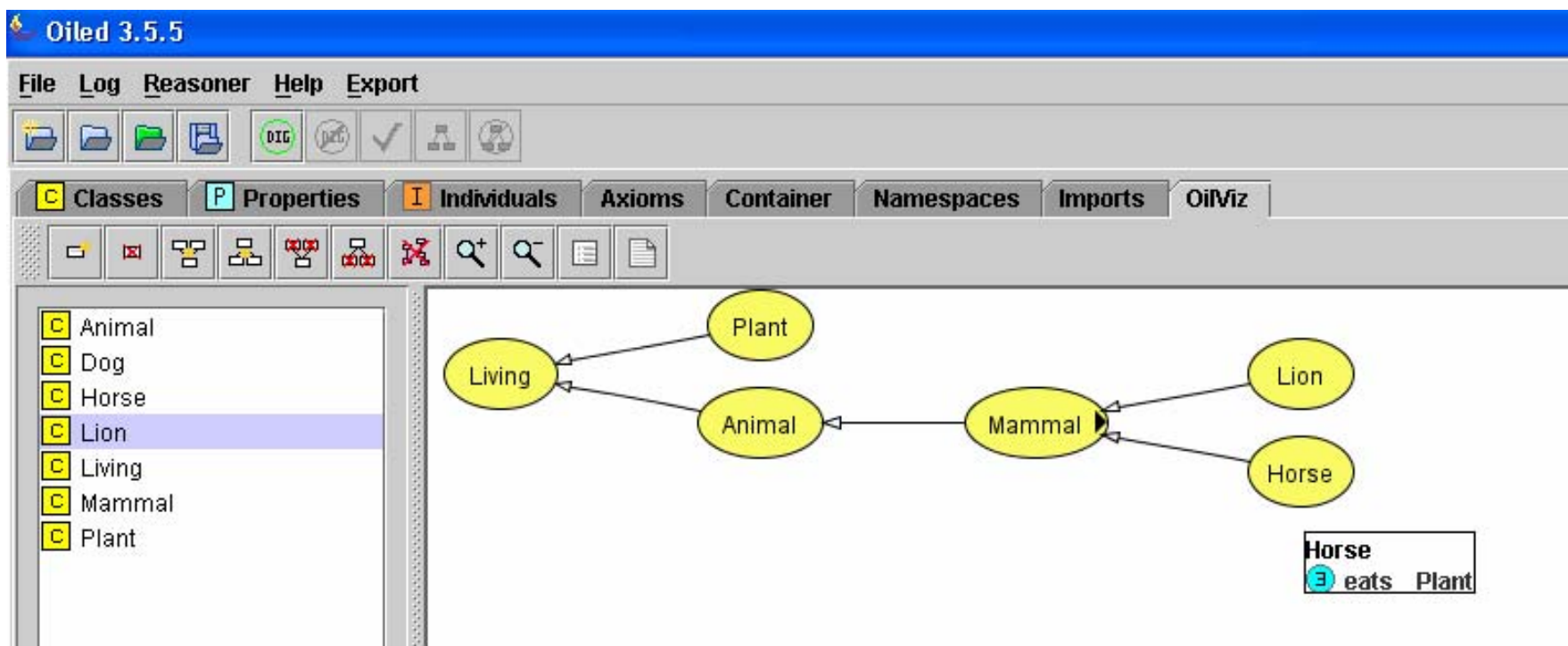
One Scenario

- Scientist has a personal agent
 - Responsible for paper submission
 - Based on an ontology it decides which conference to submit to
 - Sends paper to chair agent
 - If received before deadline, chair agent notifies that paper was submitted.
 - Chair agent distributes the paper to reviewer agents, taking into consideration paper topics and author institution....

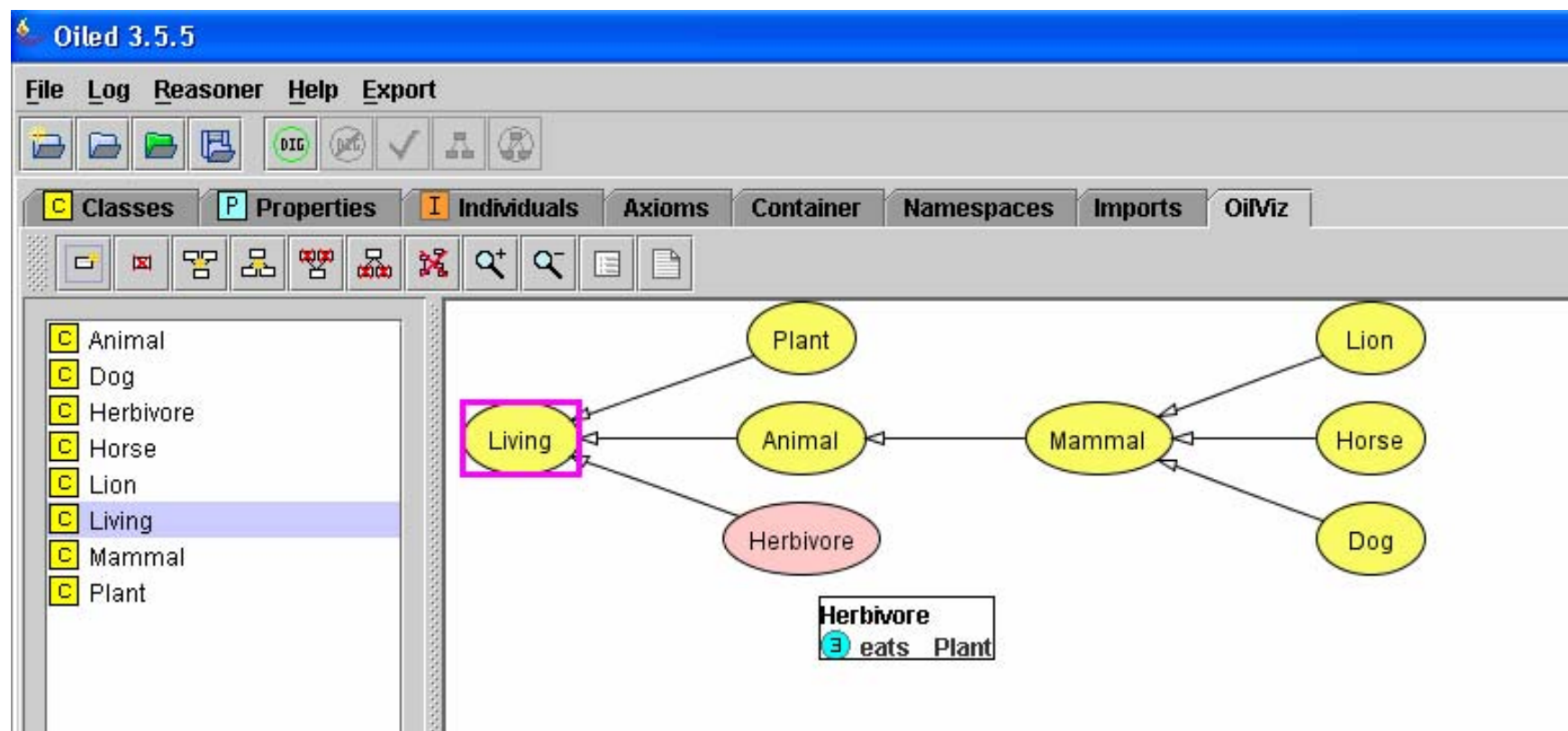
Inference Mechanisms

- Semantic Web Languages can be translated to a formal representation:
 - Deduce new logical sentences from existing ones → inference
 - First Order Logic:
 - Very expressive → widely used in KR
 - Reasoning in FOL → undecidable and intractable
 - Description Logics
 - Reduced form of FOL (to frame description)
 - Computability by limiting the expressiveness of FOL
 - Focuses on describing things and by determining the *subsumption* relationship

Example



Example



Example

```

Allegro Common Lisp Console - [shiq-app.dxl]
Allegro CL Enterprise Edition
6.1 [Windows] (Jul 3, 2003 15:58)
Copyright (C) 1985-2001, Franz Inc., Berkeley, CA, USA. All Rights Reserved

This standard runtime copy of Allegro CL was built by:
  [TC7283] University of Manchester

FaCT description logic classifier (SHIQ reasoner) v2.33.13.
Lisp is Allegro CL Enterprise Edition 6.1 [Windows] (Jul 3, 2003 15:58),
running on BOLA, a x86 machine, equipped with Microsoft Windows 9x/Me and
Copyright (C) 1997,1998,1999 Ian R. Horrocks and the University of Manch
FaCT comes with ABSOLUTELY NO WARRANTY; for details type `(warranty)'.
This is free software, and you are welcome to redistribute it
under certain conditions; for details type `(conditions)'.
CORBA FaCT server version 3.2
CL-USER(1):
:::j(1.1): Advertising Lisp server at localhost:4321.
:::jn(1.1):jNotifyLisp
:::js(1.1):jLinkServer
:::ji(1.1): Expecting
:::js(1.1):jLinkServer
:::ji(1.1): Java serv
:::ji(1.1): Lisp clie
:::ji(1.1): Expecting
:::ji(1.1): Connecte
::: Starting server (

```

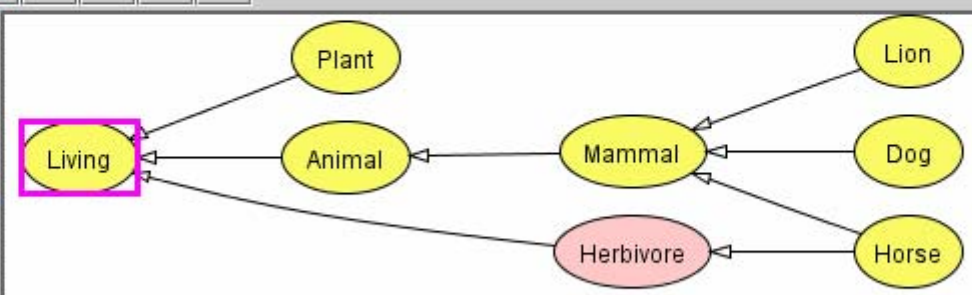
FaCT Reasoner

Oiled 3.5.5

File Log Reasoner Help Export

Classes Properties Individuals Axioms Container Namespaces Imports OIIViz

- Animal
- Dog
- Herbivore
- Horse
- Lion
- Living
- Mammal
- Plant



```

graph TD
    Living --> Plant
    Living --> Animal
    Living --> Herbivore
    Animal --> Mammal
    Herbivore --> Mammal
    Mammal --> Dog
    Mammal --> Horse
    Mammal --> Lion

```

Inference Mechanisms

- Consistency checks
- Verification tools
- Viewpoints

Trust

- Are there “*greener*” ontologies?
- How can we trust semantic content?
 - Naive assumptions
 - Honesty,
 - Users are able to describe their domains adequately,
 - No Bias.
 - Provenance
 - Traceability

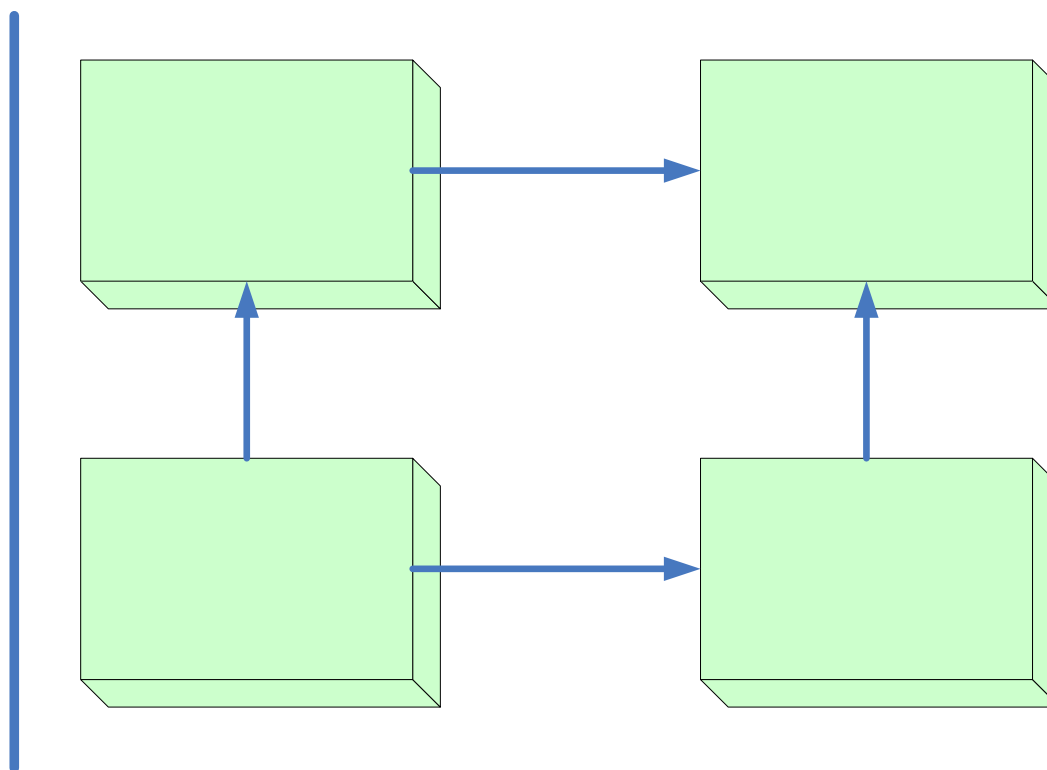
Web Services

- Authentication, Authorization and Integrity:
 - XML Signatures
 - SAML (Security Assertion Markup Language)
 - Single Sign On
 - WS- Security



Semantic Web Services

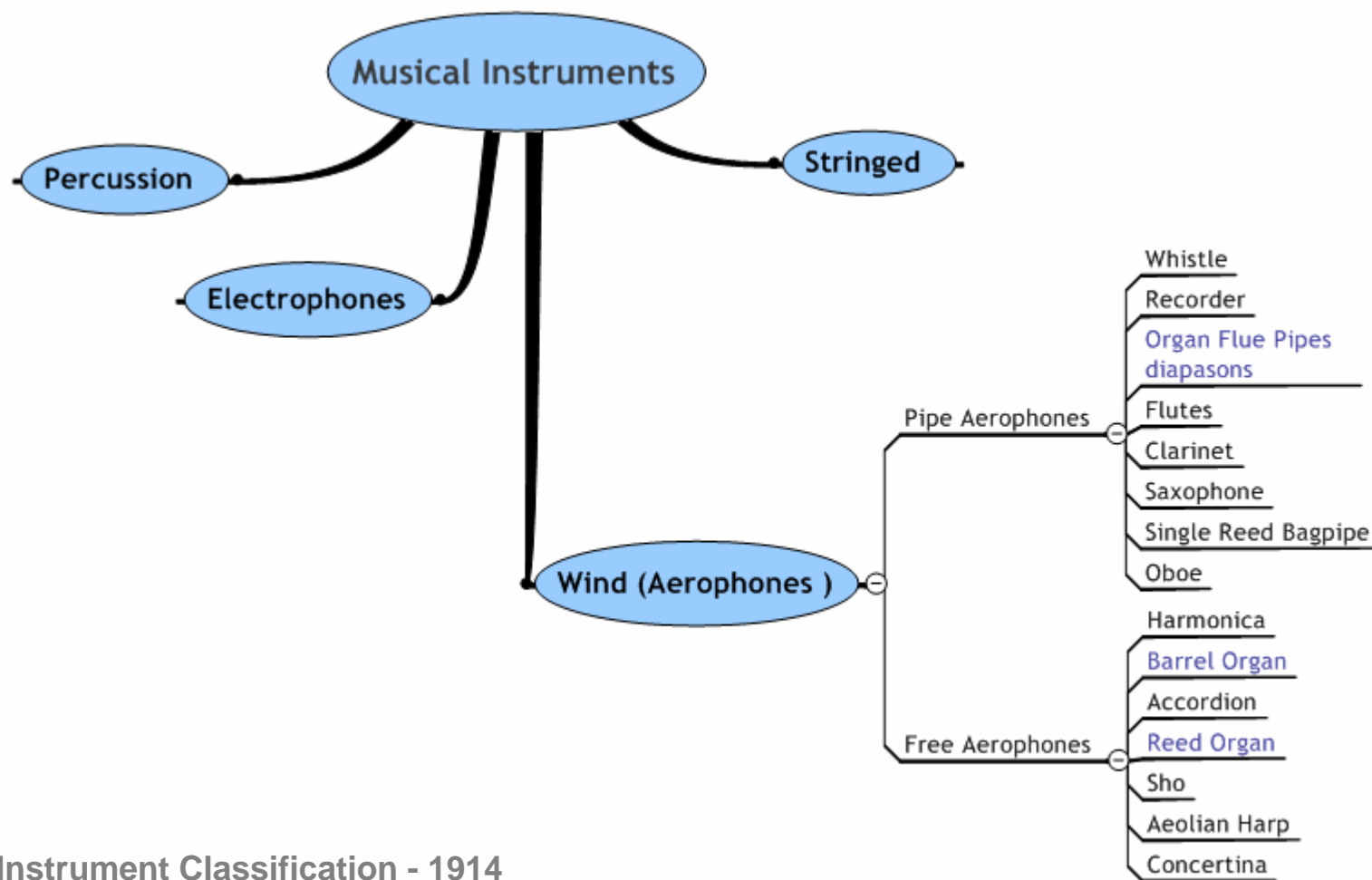
“Bringing the Web to its full potential...”



SWWS

- semantic web enabled web services
 - swws.semanticweb.org
- Ontology Adoption
 - Guarantees same interpretation by service users and providers
- Ontology mediation services
- DAML-S service ontology - provides primitives for describing service concepts and relationships.

Scenario I Revisited



Music Instrument Classification - 1914
 Erich Moritz von Hornbostel & Curt Sachs

Scenario I - Revisited

GOOGLE For: organ instrument wind

- [BUBL LINK: Wind instruments](#) ... Subjects: keyboard instruments, organ music, wind instruments DeweyClass: 786.5 Resource type: documents; Trevor Wye Corner: Atricles on various aspects ...
publ.ac.uk/link/w/windinstruments.htm - 17k - [Cached](#) - [Similar pages](#)
- [Greek and Roman Pipe Organs](#) ... amongst wind instruments by Bellermann's "anonymus," (Anonymi de Musica, ... the idea of his organ from the Syrinx or Pandean pipes, a musical instrument ...
[Wind instruments, Woodwind, Organs](#) Woodwind, wind instruments, organs, the flute: a web directory.
- [The Classical Free-Reed, Inc. Taxonomy of Musical Instruments](#) ... by the wind, can be convincingly classified as a free-reed instrument, ... the organ belongs to both the edge instruments and reed pipe instruments. ...
- [American Music - Software - Software Synthesis/Sampling - B4 Organ ...](#) ... B4 Organ VST Keyboard Native Instruments (Mac/Wind Item # TW-ninb42 -ZB Click for Larger Picture. This product is eligible for FREE SHIPPING! ...
- [St. John's Presbyterian Church - The Organ](#) ... The organist who plays an instrument with flexible wind must refine his or her playing technique in response to factors that simply do not arise with a ...
- [Rieger - Kloss \[The History \]](#) ... The actual first ancestor of the organ is the Chinese instrument "sheng". ... in organ playing was the introduction of spring and slider wind-chests. ...
- [organ: Information From Answers.com](#) ... Organs were the first keyboard instruments, even though technically they ... Other wind instruments that have no reservoir of gas but use a separate ...

Scenario II - Revisited

- Lucy's mom needs physical therapy sessions:
 - Software Agent working on Lucy's behalf
 - Lucy is driving her, needs to be near her place of work
 - metadata
 - Should be a good professional
 - Trust layer - not quite there yet.
 - Should belong to her medical plan
 - metadata
 - Should have openings compatible with Lucy's agenda
 - software agent compares Lucy's and Doctor's agendas using concepts such as time, session, working hours.... negotiated between their **ontologies** - we assume both ontologies are **consistent (inference mechanisms)**.

What the semantic web is NOT

- AI
 - Machine processable data and documents DO not imply that computers now magically gain **understanding**
 - Many techniques come from AI
 - Partial solutions are acceptable in the SW
 - “if AI’s goal is to build agents that possess intelligent equal (or superior) to that of human beings, the Semantic Web wants to help humans accomplish daily chores on the web”. Antoniou & Harmelen
- The semantic web is not a **separate** web.
 - Layered architecture
 - Refactoring
- Not every application in the semantic Web will need to explore its full potential
 - Solution complexity depends on the problem
 - W3C provided for three versions of OWL - lite, DL & Full

What to expect?

- Immediate Result:
 - reduce load on end users

- Collateral Effect
 - Esperanto versus Tower of Babel
 - perhaps, we will create knowledge representation models that can be globally shared...