Semantic Web

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Corso di Fondamenti di Intelligenza Artificiale M

Outline

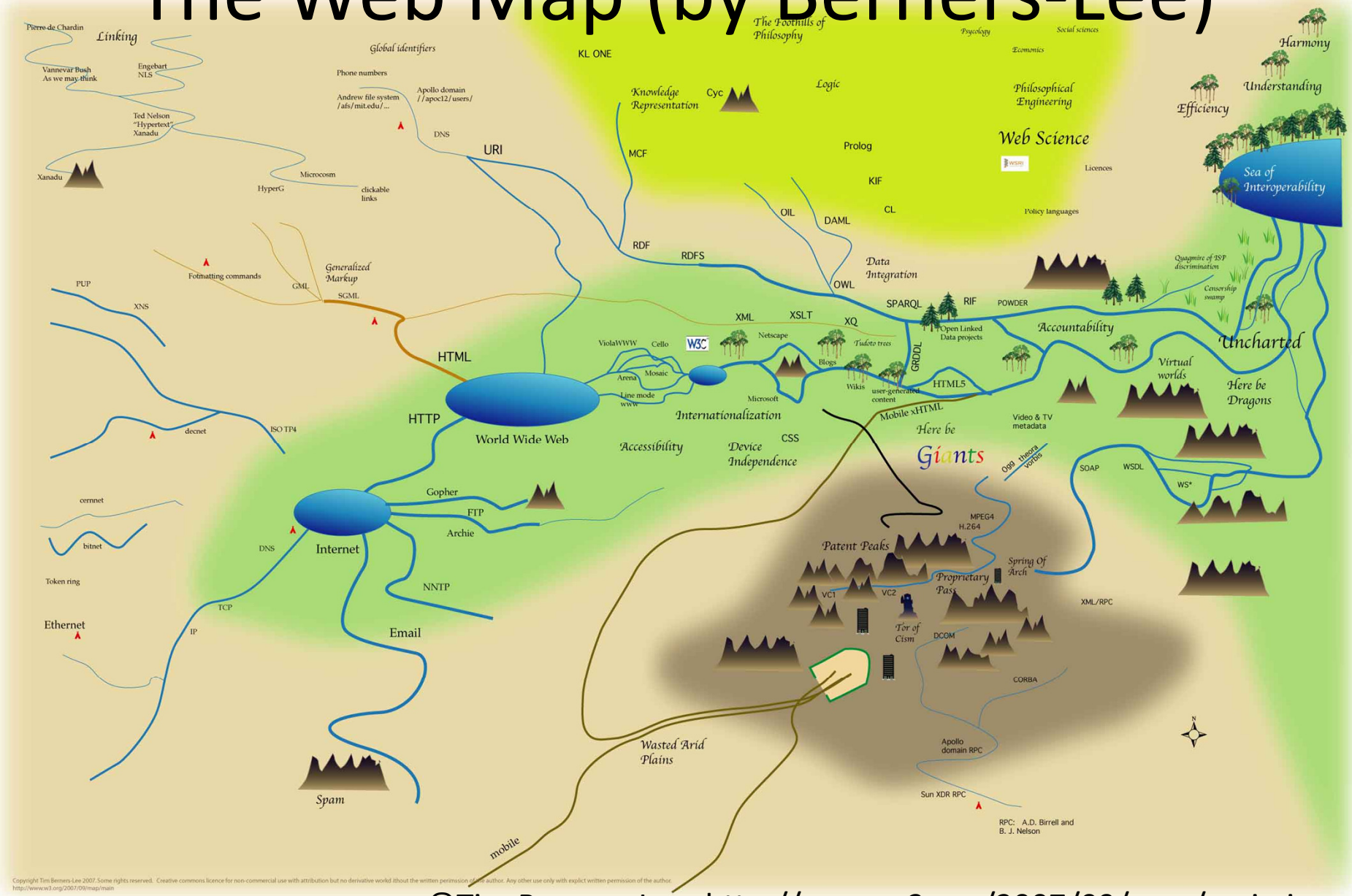
1. Introduction
   a) The map of the Web (accordingly to Tim Berners-Lee)
   b) The current Web and its limits
   c) The Semantic Web idea
   d) Few examples of Semantic Web applications

2. Semantic Information (a bird's eye view)
   a) Semantic Models
   b) Ontologies
   c) Few examples

3. Semantic Web Tools
   a) Unique identifiers - URI
   b) XML
   c) RDF and SPARQL
   d) OWL

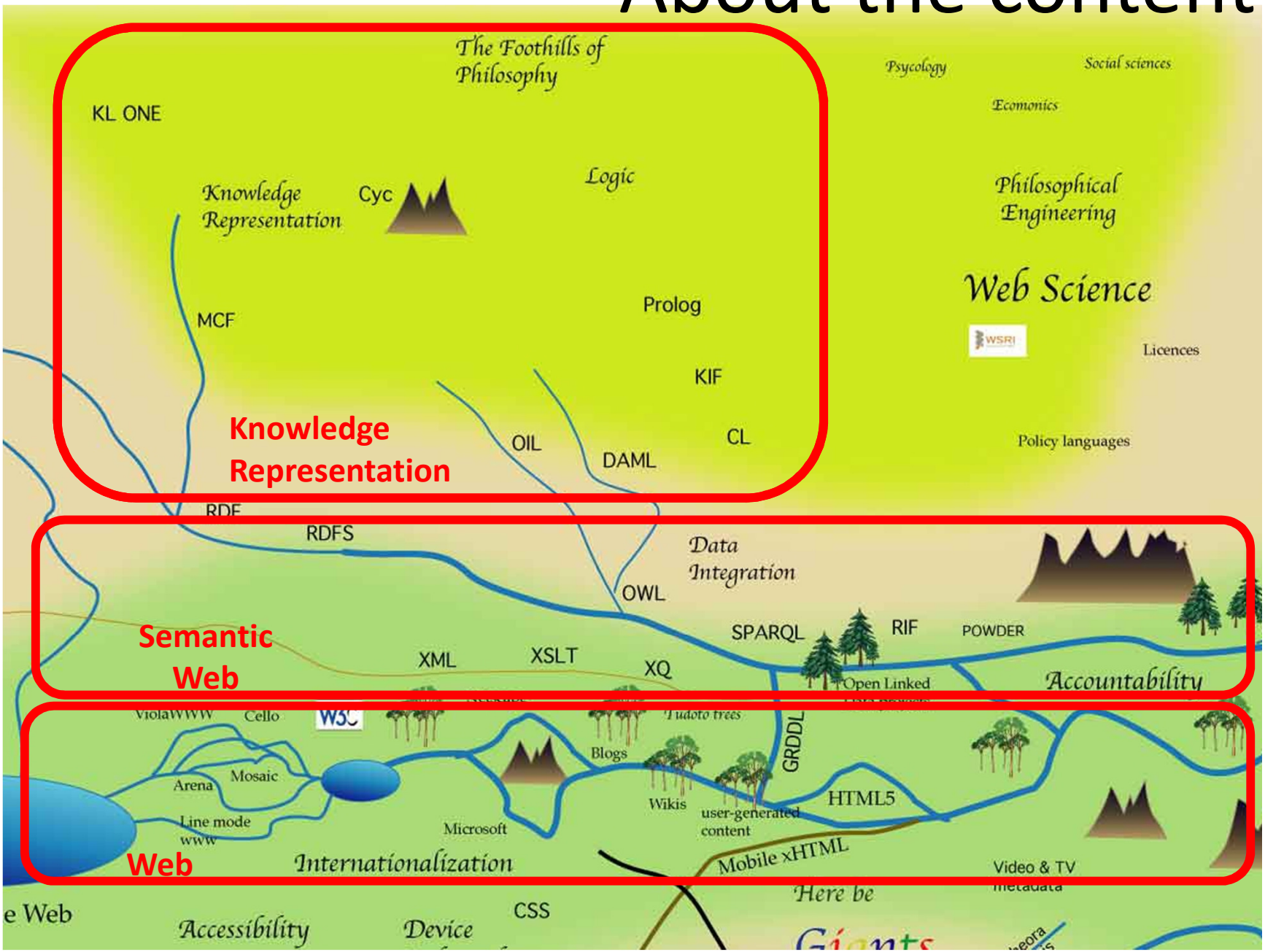
4. Semantic Web: where are we?
   a) Problems against the success of SW proposal
   b) Critics against SW
   c) Few considerations
   d) Few links to start with

The Web Map (by Berners-Lee)



©Tim Berners-Lee, http://www.w3.org/2007/09/map/main.jpg

About the content



The Web 1.0 …

- Information represented by means of:
  - Natural language
  - Images, multimedia, graphic rendering/aspect
- Human Users easily exploit all this means for:
  - Deducting facts from partial information
  - Creating mental asociations (between the facts and, e.g., the images)
  - They use different communication channels at the same time (contemporary use of many primitive senses)

The Web 1.0 …

- The content is published on the web with the principal aim of being "human-readable"
  - Standard HTML is focused on *how* to represent the content
  - There is no notion of *what* is represented
  - Few tags (e.g. <title>) provide an implicit semantics but …
    - … their content is not structured
    - … their use is not really standardized

The Web 1.0 …

Sembrava tutto fatto, invece approvato un solo articolo. All'origine del blocco il no di Mastella all'art.91

Finanziaria, il voto slitta a domani
Al Senato va in scena l'assurdo

Dini ripete: "Mani libere fino all'ultimo". Prodi ottimista

di CLAUDIA FUSANI

Lamberto Dini

ROMA – L' "assurdo" è andato in scena oggi nell'aula di palazzo Madama sfidando la logica, il buon senso, la corretta gestione della politica e lasciando il passo alle monovre di palazzo. Doveva essere il giorno dell'atteso e faticoso voto finale alla Finanziaria. Alle nove e mezzo del mattino, quando il presidente del Senato Franco Marini riprende i lavori mancano sette articoli – dal 91 al 97 – e circa ottanta votazioni. Poche ore ed è finita. Alle otto di sera, invece, l'articolo 91 è stato accantonato – rinviato – il 92 approvato, il 93 in piena discussione. E anche molto vivace. Si e no sono state fatte una decina di votazioni. Un impasse assurdo, kafkiano, che racconta una delle pagine più incredibili di questa

```
<h1>
  <!-- inizio TITOLO -->
  <B>Finanziaria, il voto slitta a domani<br>
    Al Senato va in scena l&#039;assurdo</B>
  <!-- fine TITOLO -->
</h1>
```

We can identify the title by means of its representation (<h1>, <b>) …

… what if tomorrow the designer changes the format of the web pages?

The Web 1.0 …

- Web pages contain also links to other pages, but ...
  - No information on the link itself …
    - … what does a link represent?
    - … what does the linked page/resource represent?
  - E.g.: in my home page there are links to other home pages ...
    - Which ones link to colleagues?
    - Which ones link to friends?

The Web 1.0 …

Actual Web = Layout + Routing

The problem: it is not possible to *automatically reason* about the data

The Web 1.0 …

- We can see the Web as an immense *database*, every day queried by millions of users
  - Users access it through *search engines* and *keywords …*
  - … successfull search depends on many parameters
    - the “quality” of the indexing and search algorithm
    - the number of total pages that have been indexed
    - the (meta-)content of the pages
  - E.g.: google, US election in 2005, and the keyword “stupid”

The Web 1.0 …

- The web is *global*
  - Any page can link to anything
  - Approximatively, anyone can publish anything on the web, about any topic
    - *Distribution* of the information
    - *Inconsistency* of the information
    - *Incompleteness* of the information
  - Some recent attempts to limit such freedom (with mixed results)

And the Web 2.0 ?

- Term referring to O'Reilly Media Web 2.0 Conference, 2004 (but no coined there).
- A new way of using the web (rather than technical advances)
- Roughly (but really roughly) speaking:
  - Possibility of user of *adding/sharing content* (without being web editors)
  - Strong, unpredictable (???) *social participation* (blogs, wikis, social networking, participation, youtube, folksonomies)
  - Possibility of *net-distributing applications* (hosted services, web services, cloud computing, web-office)

And the Web 3.0 ?

Ummh... Oooh...
Well... I am not
really sure...

The “Press Any Key” Dilemma

And recently I heard
also of Web 4.0...

Semantic Web

Goal: “*use*” and “*reason upon*” all the available data on the internet *automatically*

How? By *extending* the current web with *knowledge* about the content (*semantic information*)

Semantic Web

"The Semantic Web is about two things. It is about common formats for integration and combination of data drawn from diverse sources, where on the original Web mainly concentrated on the interchange of documents. It is also about language for recording how the data relates to real world objects. That allows a person, or a machine, to start off in one database, and then move through an unending set of databases which are connected not by wires but by being about the same thing."

SOURCE: W3C Semantic Web Initiative

Semantic Web

Principles SW would like to preserve:

- Globality
- Informaton distribution
- Information inconsistency
  - Content inconsistency
  - Link inconsistency
- Information incompleteness
  - … of contents
  - … of routing information (links)

Adding information about the content

Adding information is not enough

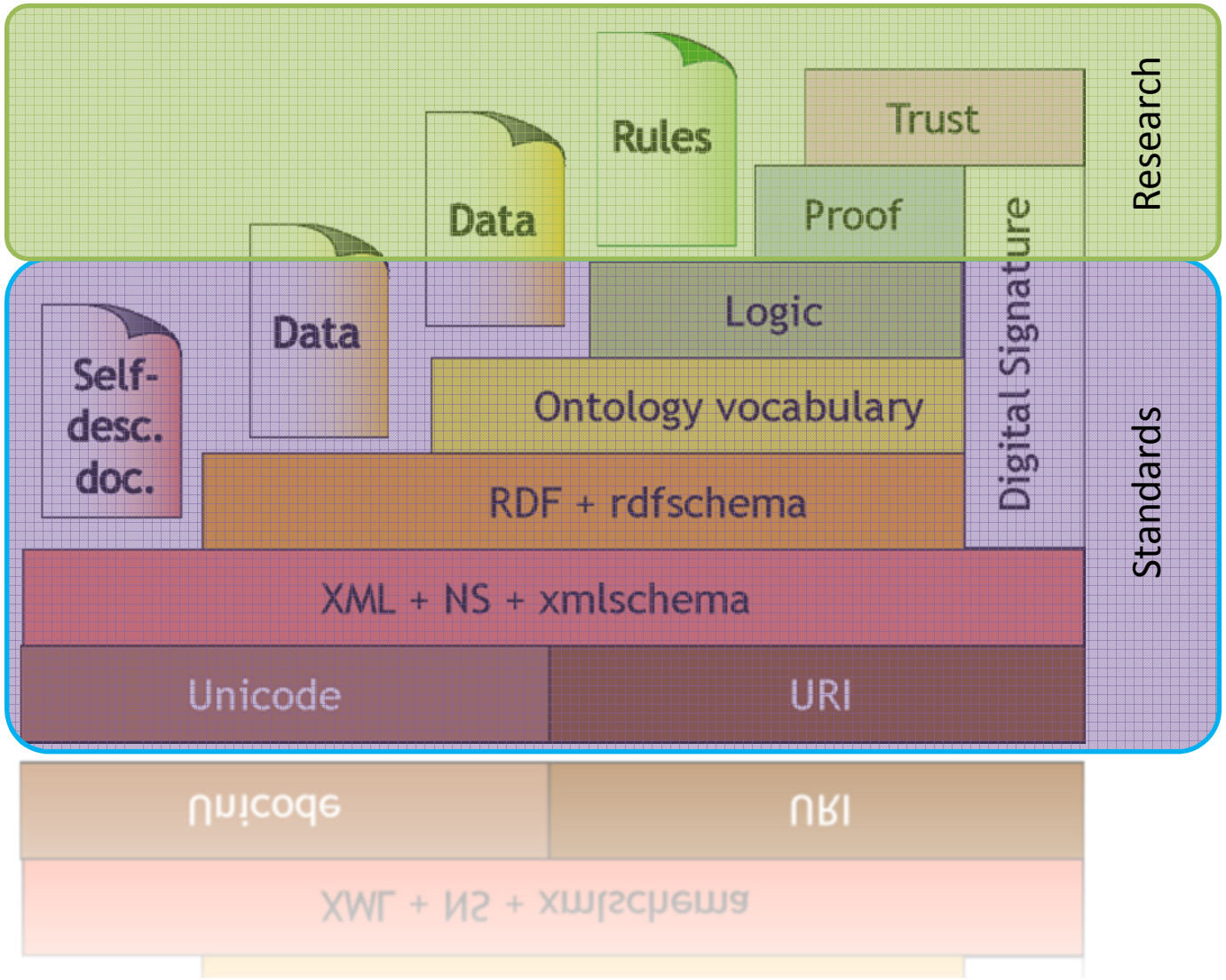
- Information should be structured (e.g., Linneo classification for the living world)
  - *Ontologies?*
- There is the need of some inference mechanism (e.g., sillogism, FOL, DL algorithm)
  - *Logic?*
- We should be able to infer new knowledge
  - We need the *proofs* that originated such new knowledge

Proof and Trust

We could exchange the proofs to …

- … justify new inferred knowledge
- … overcome the definitory aspect of IT
- … reason upon the trust...

Semantic Web Architecture



SW – Applications?

SW is cross-domain (as ICT): standards and tools have application fields in every possible domain.

To cite some:

- Search engines
- Intelligent Assistant
- Database Integration
- Digital libraries (XMP Adobe)
- Web services and cloud computing (Semantic Web Services)

Applications
Document search

- Industries (mid-size and more) needs to index and easily access/retrieve all the documentation
  - GSA - Google Search Applaince
    - (2007 prices: $1,995 up to 50.000 docs, $30,000 up to 500.000 docs)
    - (2010 prices: not available, 2-3 yrs contract, depend on the number of indexed documents)
  - Microsoft Sharepoint Search Services/Server

- Vodafone Live! Mobile Portal based on RDF (SW)
  - For each download, 50% less pages accessed
  - 20% increment of downloaded stuff in 2 months (source: Ivan Herman, SW lead)

Applications
Other portals …

- Sun’s White Paper and System Handbook
- Harper’s Online magazine – papers linked by means of an internal ontology
- Oracle - virtual press room
- Opera’s community site
- Yahoo! Food
- FAO's Food
- Nutrition and Agriculture Journal

Applications
Intelligent Assistant

- Original Scenario proposed by Tim Berners-Lee
- Two users, by means of a “Semantic Web Agent” (running on your phone):
  - Synchronize the agenda
  - Generate and agree upon a plan
  - Delegate tasks each other
  - Exploit business contracts to support cost-based decisions

Applications
Intelligent Assistant - revisited

- We can access on-line to:
  - Bank account
  - agenda
  - Photo album
- ... But there is no real integration:
  - We can’t merge the agenda with the payments enrolled a certain day…

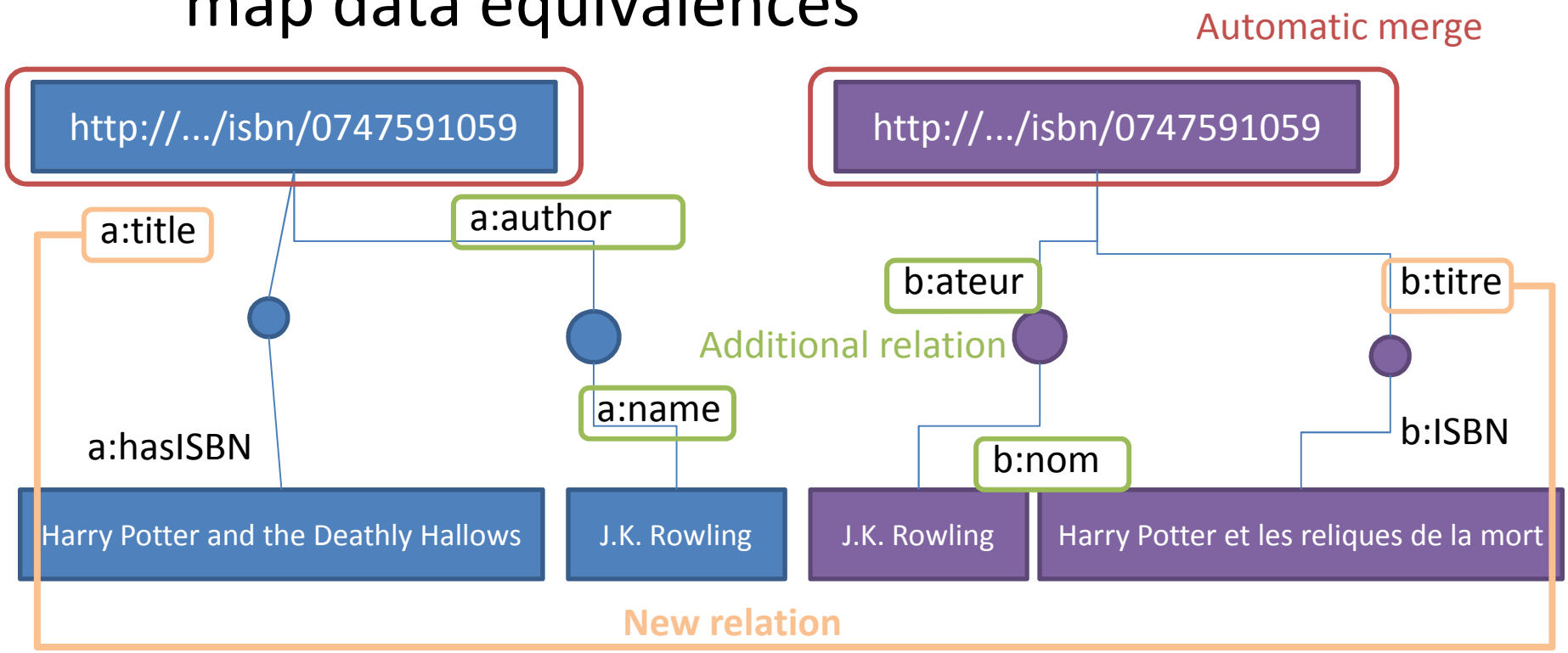
- Less reasoning and more data integration!!!

Applications
Data Integration

- Frequent need to integrate several different databases
- Roughly:
  1. Define new, more abstract data structures, to capture the data heterogeneity
  2. Merge of such abstract representations
     - Real Merge vs. Virtual merge
  3. Finally, more complex and more expressive queries

Applications
Data Integration

- The merge is successfull if the data abstration process correctly identifies and map data equivalences



Applications
Data Integration

- SW intrinsecally supports such data abstraction process
- Differences:
  - The entire web is the background
  - Data are considered as distributed
  - Use of ontologies (more expressivity of the E/R model)
- Tools:
  - RDF
  - GRDDL
  - Open Data Link Initiative

Applications
Libraries and Digital Libraries

- Indexing happens by means of categories
  - We can access a library by means of its content/topics catalog

- This is not true with the current web
  - E.g.: looking for something related to the concept of “Artificial Intelligence”
  - … we get as a result a list of resources containing the keywords…
  - … no guarantee about such resources are indeed about AI...

  - Another example: suppose you want to download a disney movie for your children...
  - ... you have many chances to download an adult movie without knowing it ...

Applications
Libraries and Digital Libraries

- Digital Libraries are evolving quickly
  - Many attempts at the EU level to standardize digital content search and access (e.g. EUROPEANA, http://www.europeana.eu/portal/)

- New, complete different models to organize the knowledge
  - The FRBRoo ontology proposal, already supported at the national level in some EU countries

Applications
Semantic Web Services

"A Web service is a software system identified by a *URI*, whose *public interfaces* and *bindings* are defined and described using *XML*. Its definition can be *discovered* by other software systems. These systems may then *interact* with the Web service in a manner prescribed by its definition, using *XML based messages* conveyed by *internet protocols*."

("Web Services Architecture"
http://www.w3c.org/TR/2002/WD-ws-arch-20021114)

Applications
Semantic Web Services

- Through UDDI and WSDL it is possible to dynamically retrieve binding (location) and interface of a service ...
- ... but no way of knowing what such service does ...
- Es: invoke a service called `sum`, accepting two `integers` as input parameters, and an `integer` as output parameter. How do we know that such service calculate the sum?

Applications
Semantic Web Services

We need two extra information:

- Semantic description of the functionality offered by the service
  - E.g.: preconditions, input, output and effects

- Rules about:
  - How to invoke the service
  - Which constraints about the data

Applications
Semantic Web Services

A lot of interest about them, from both industrial and academic fields

- Two contests in the academic arena
  - IEEE Contest

    http://insel.flp.cs.tu-berlin.de/wsc06/

  - SWS Challenge

    http://sws-challenge.org/wiki/index.php/Main_Page

SWS tools

- Several proposals, no winner yet ...
  - Semantic Annotations WSDL (SAWSDL) (W3C)
  - Semantic Web Service Language (SWSL) (W3C)
  - OWL Web Services Ontology (OWL-S)
    - Supported in US by DAML (DARPA Agent Markup Language)
  - Web Service Modeling Ontology (WSMO)
    - Supported in EUby DERI (Digital Enterprise Research Institute: Galway, Seoul, Stanford)

Semantic Information

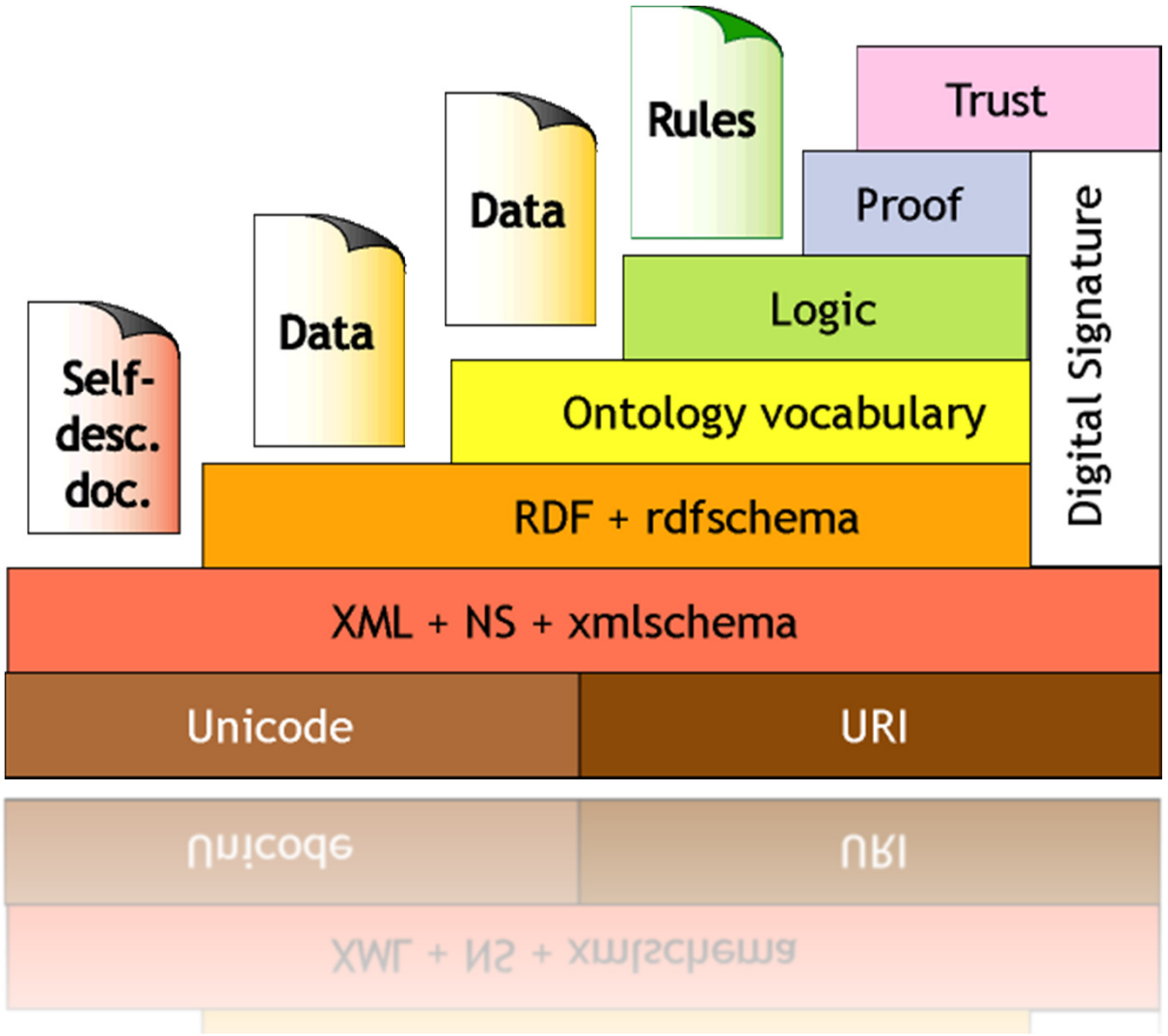
Semantic Models

How to represent semantic information?

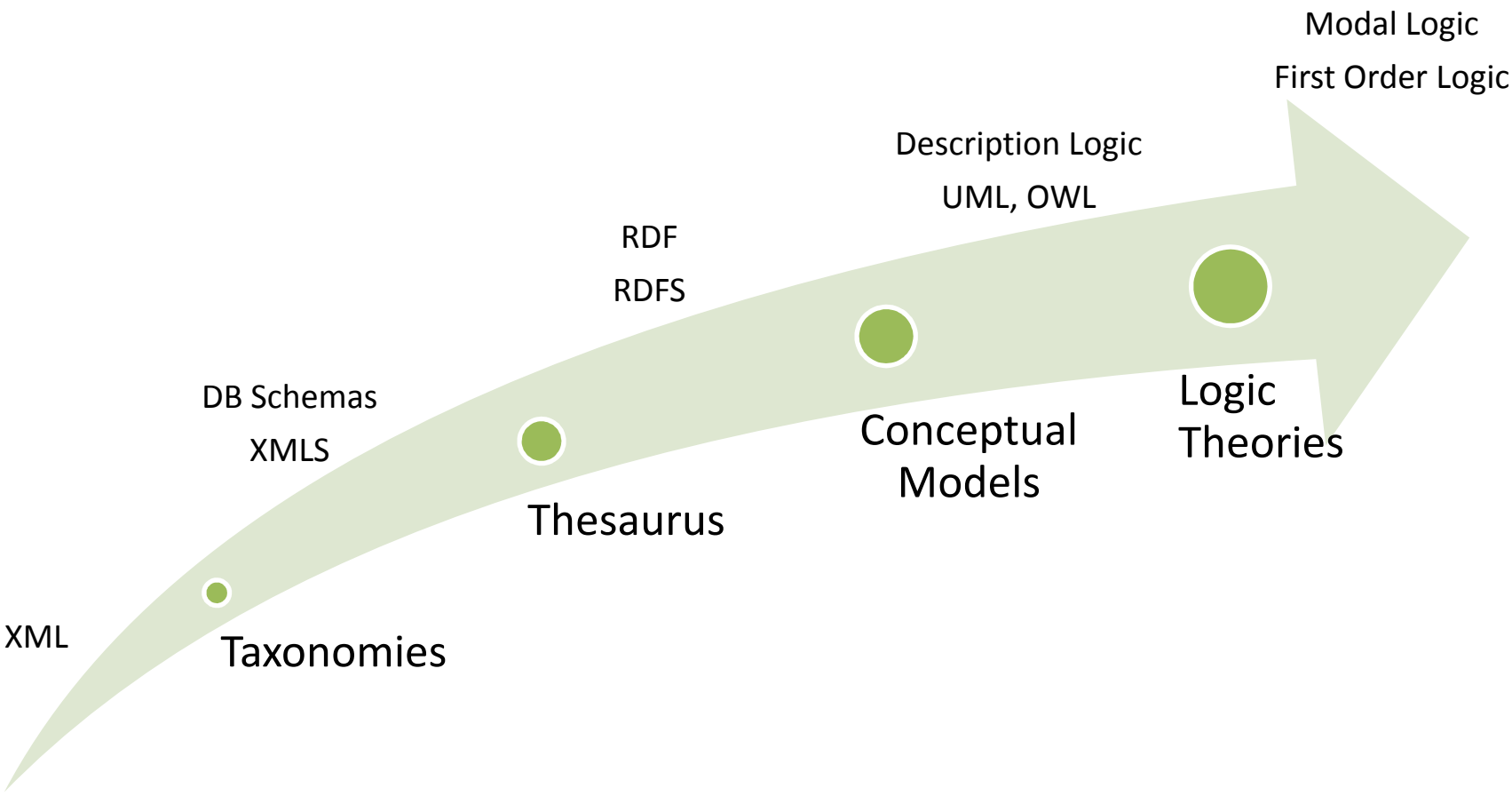
- Which language?
- Which expressivity?
- Reasoning? What about performances?

At this point, Semantic Web meets the Knowledge Representation research field (from AI)

Semantic Web Architecture



Semantic Models



Semantic Models

- Taxonomy: a set of *terms*, *hierarchically* organized
  - Allows to represent that there are relations among terms …
  - … but does not permit to describe the nature of such relations
  - Tipically, father/child node relation
  - Search of a term is efficient only if you already know where to look for....

Semantic Models

An example of taxonomy we have to deal with: IEEE Computer Society Keywords http://www.computer.org/portal/web/publications/acmtaxonomy , approximatively 1766 terms hierarchically structured ...

Caterogy: Artificial Intelligence

IV. Knowledge Representation Formalisms and Methods

I. Agent communication languages
II. Distributed representations
III. Frames and scripts
IV. Knowledge base management
V. Knowledge base verification
VI. Modal logic
VII. Predicate logic
VIII. Relation systems
IX. Representation languages
X. Representations (procedural and rule-based)
XI. Semantic networks
XII. Storage mechanisms
XIII. Temporal logic

V. Programming Languages and Software

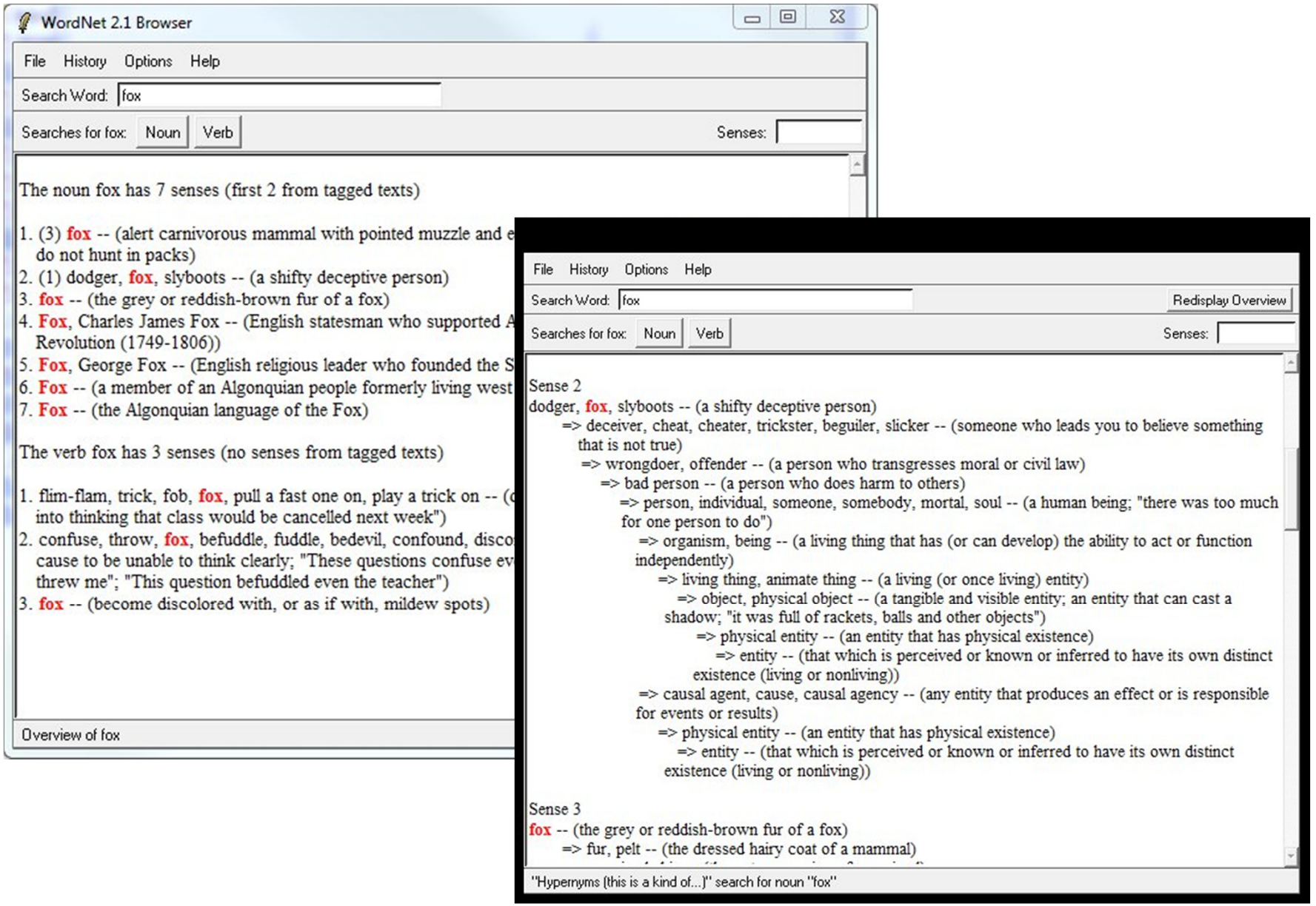
I. Expert and knowledge-intensive system tools and techniques

Semantic Models

- Thesaurus: orignally from linguistic research field, it is a set of terms togehter with (linguistic) relations among them:
  - Synonym
  - Hyperonyms
  - Hyponims
  - Holonyms
  - Meronyms
  - ...

  They address typical problems in natural language, such as ambiguity and redundancy
  - WordNet (©Princeton University), http://wordnet.princeton.edu/

Semantic Model: thesaurus



Semantic Models

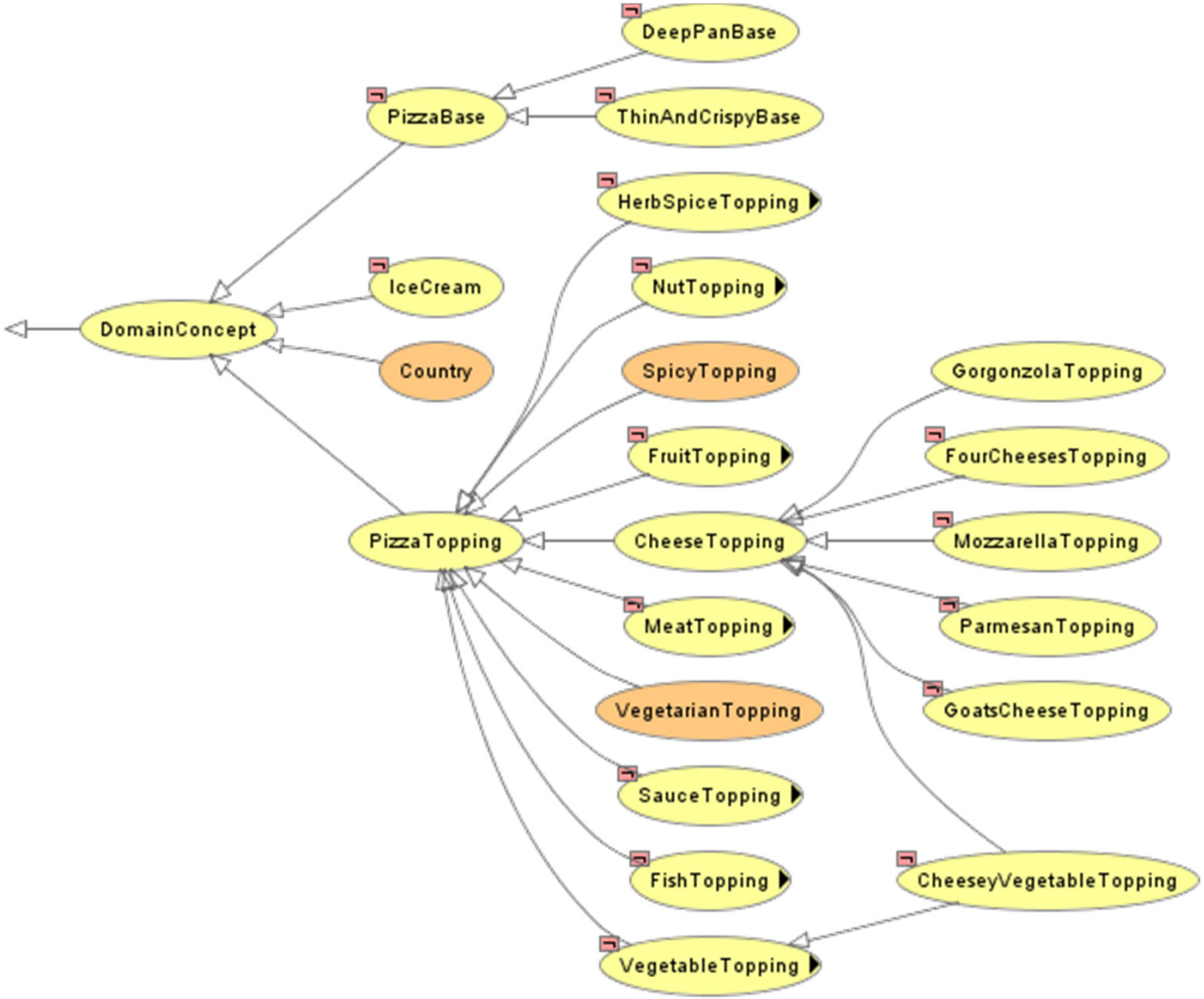
- Conceptual models: focused on a particular *domain area*. They specify:
  - Domain *entitites*
  - Relations between the entitites (properties and attributes)
  - Rules about classes, roles and relations
  - Inference mechanisms -> *Logic theories*!!!

Ontologies – a definition

An ontology is a formal, explicit description of a domain of interest

- Classes
- Semantic relation between classes (roles)
- Properties associated to a concept (e.g., restrictions)
- Logic (axioms, inference rules)

Ontologies – an example



Ontologies

An ontology is a formal, explicit description of a domain of interest

- They are a fundamental piece, independently of Semantic Web
- The issues are in the “subtle distinction of meaning”
- They have been a research field in AI since the beginning

Ontologies

Do we really miss them?

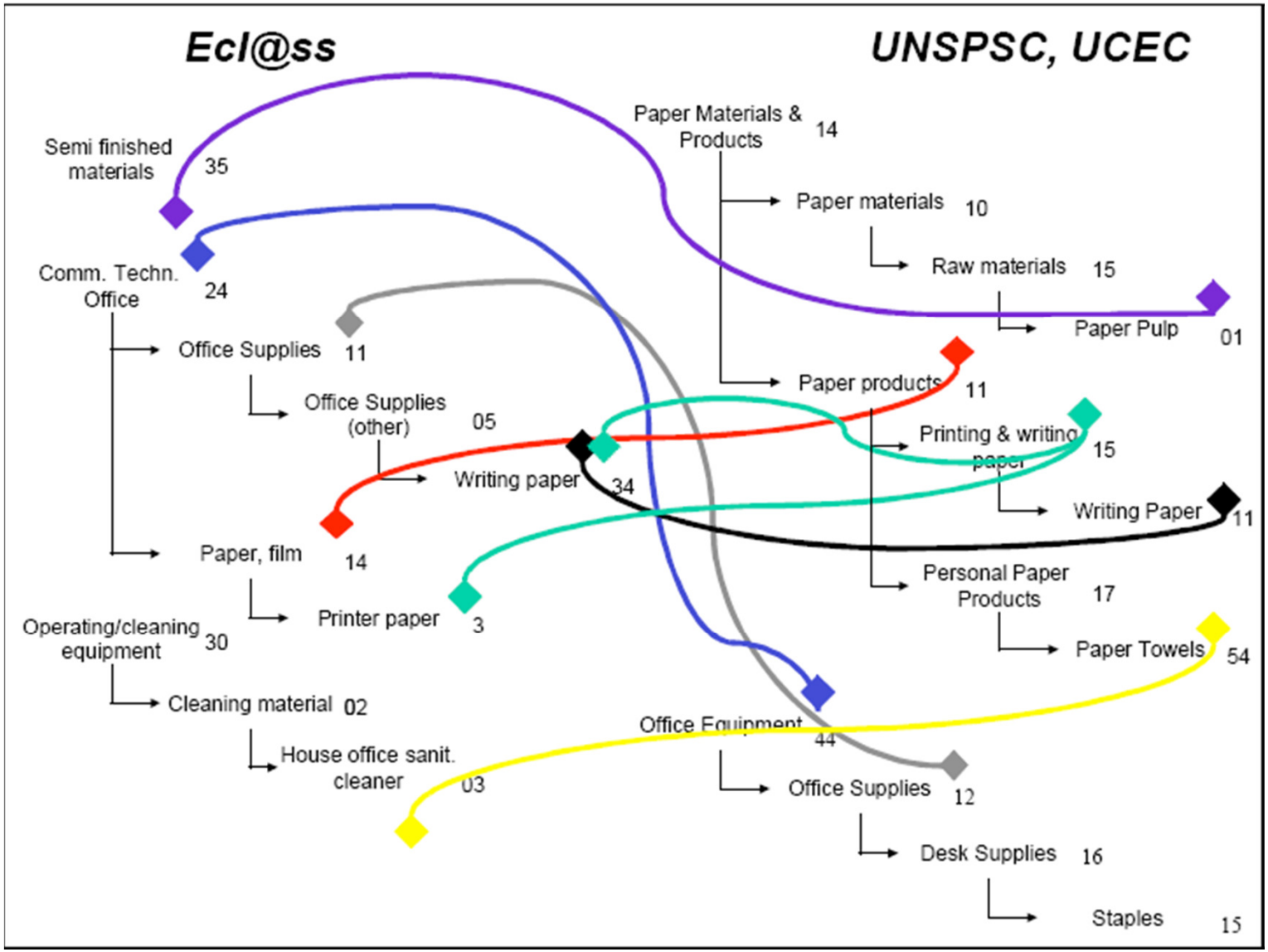
Crisis of dotCom market (2001)

Harvard Business Review, October 2001:

"Trying to engage with too many partners too fast is one of the main reasons that ***so many online market makers have foundered*****.**
The transactions they had viewed as simple and routine actually involved many ***subtle distinctions in terminology and meaning***

Ontologies

Do we really miss them?



Ontologies

XML is not enough?

"XML is only the first step to ensuring that computers can communicate freely. ***XML is an alphabet for computers*** and as everyone who travels in Europe knows, knowing the alphabet doesn't mean you can speak Italian or French"

Business Week, March 18, 2002

Why ontologies?

- An ontology provides a structured model of a (business) domain
  - Solves term ambiguity
  - Clarifies/simplifies domain peculiarities
  - As a consequence, deep analysis and understanding of a (business) domain …
  - … high competitive advantage !

Ontologies

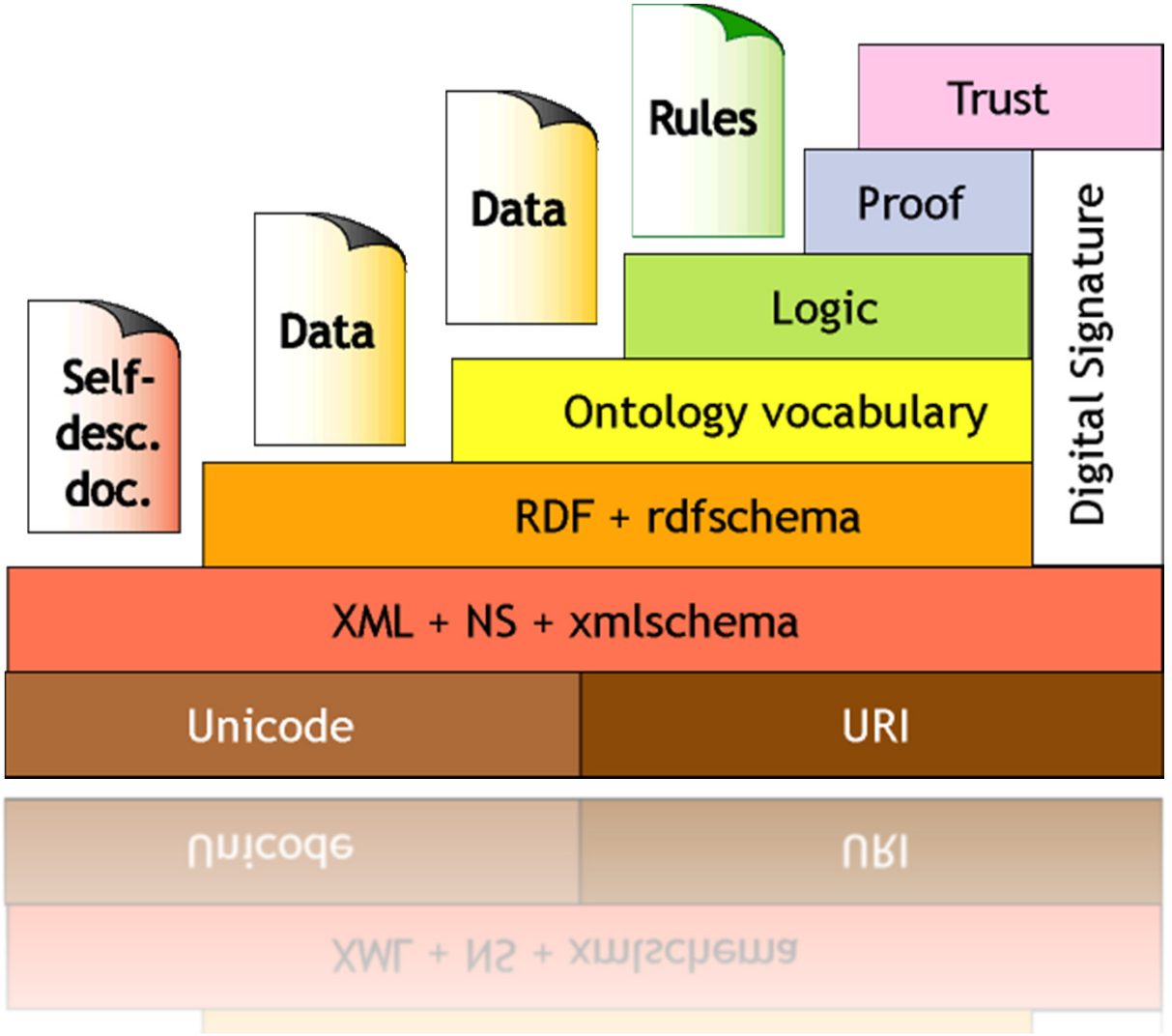
Few examples:

- Dublin Core, focussed on documents
- WordNet
- Gene Ontology, genomic
- Protein Ontology, proteomics
- SnoMed, a very important ontology in the medical field

- 41 use case and examples available at http://www.w3.org/2001/sw/sweo/public/UseCases/

Semantic Web Tools

Recalling the Semantic Web Cake



A unique way for identifying concepts

- How to uniquely identified concepts?

  -> by means of a name system ...

- SW exploits an already available name systems, URIs (*Uniform Resource Identifier*)
  - By definition, URI guarantees unicity of the names
  - To each URI corresponds *one and only* one concept ...
  - … but more URI can refer to the *same* concept!
  - NOTE: differently from the web, it is not necessary that to each URI corresponds some content!

Examples:
http://www.repubblica.it
federico.chesani@unibo.it
ISBN 88-7750-483-8

Uniform Resource Identifiers (URI)

- The URI is used as name system by all the internet
- Beginning og the ‘90 distinction between
  - Uniform Resource Locator (URL)
  - Uniform Resource Name (URN)
- Nowadays it does not matter anymore, and they are used in an equivalent manner

Uniform Resource Locator

- A particular type of URI
- Identify the resource by expliciting also the access mechanism:

http://lia.deis.unibo.it/~fc/LIAIndex.html

Access scheme

Network location

eXtensible Markup Language - XML

- Created for supporting data exchange between heterogeneous systems (hardware and software)
  - No presentation information
  - Human readable and machine readable
- Extensible, so that anyone can represent any type of data
- Hierarchically strcutured by means of *tags*
- An XML document can contain, in a preamble, a description of the grammar used in such document (optional) (self-describing document!!!)
- Very mature technology!

eXtensible Markup Language - XML

- XML is equipped with two different dialectsfor specifying the grammar of a XML dialect
  - Document Type Definition (DTD)
  - XML Schema
    - Data types
    - Namespaces
    - Uses XML syntax itself
    - Higher expressive power with respect to DTD
- Concept of valid document (no grammar) and well formed document (defined by means of a grammar)

eXtensible Markup Language - XML

- Complete frameworks for XML Document managing (DOM e SAX) are available
- XSL (XML Stylesheet language)
  - XSLT (XSL Transformation)
  - XPath, language for defining expressions (query/matching XML documents)
  - FO (Formatting Objects)

Resource Description Framework (RDF/RDFS)

- Standard W3C
- XML-based language for representing “knowledge”
- A design criteria:provide a “minimalist” tool
- Based on teh concept of triple:

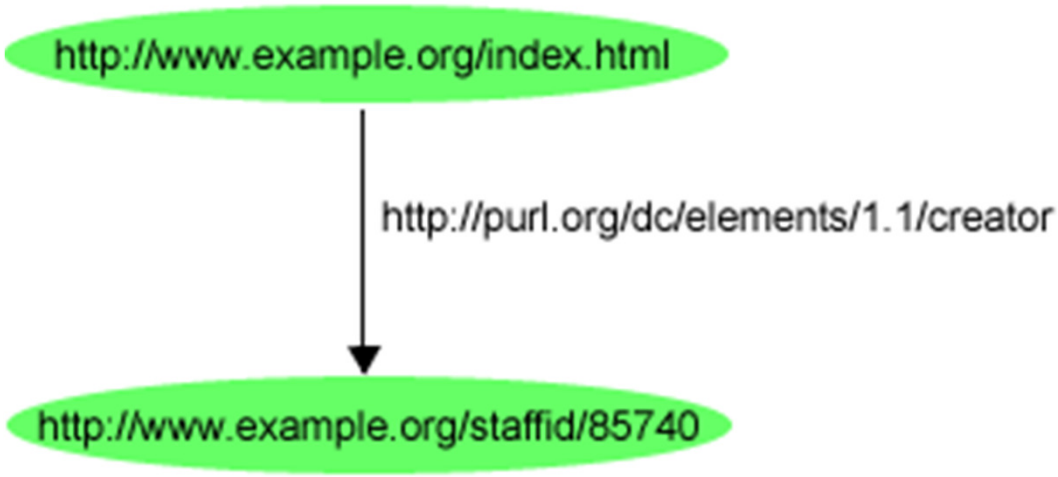
< subject, predicate, object>

< resource, attribute, value>

- Some different representations (N3, Graph, RDF/XML)

RDF – Graph Representation

- A node for the subject
- A node for the object
- A labeled arc for the predicate



http://www.example.org/index.html has a creator whose value is John Smith

RDF – Graph Representation

RDF – XML Representation

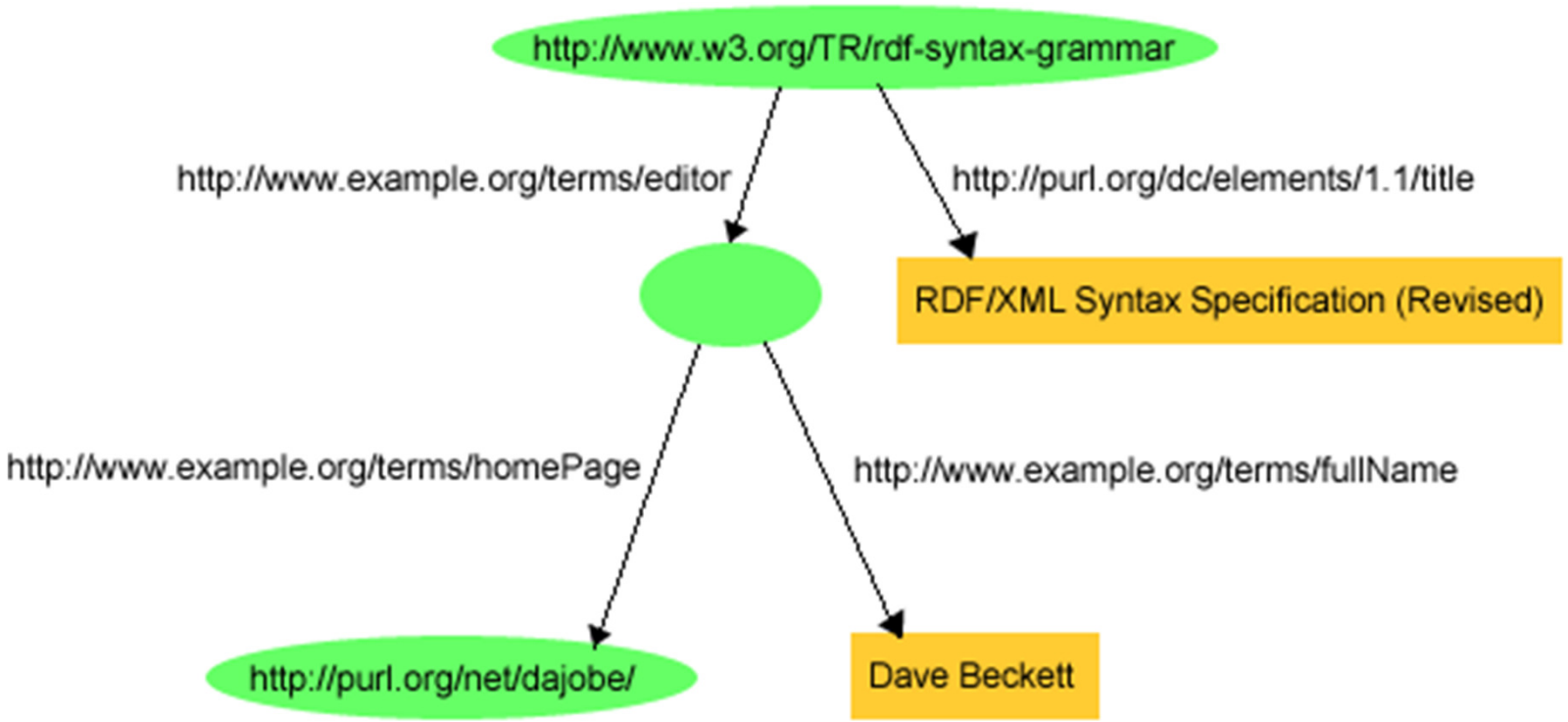
```
<rdf:RDF
    xmlns:rdf=http://www.w3.org/1999/02/22-rdf-syntax-ns#
    xmlns:contact=http://www.w3.org/2000/10/swap/pim/contact#
>

    <contact:Person    rdf:about="http://www.w3.org/People/EM/contact#me">
          <contact:fullName>Eric Miller</contact:fullName>
     <contact:mailbox rdf:resource="mailto:em@w3.org"/>
     <contact:personalTitle>Dr.</contact:personalTitle>
    </contact:Person>

</rdf:RDF>
```

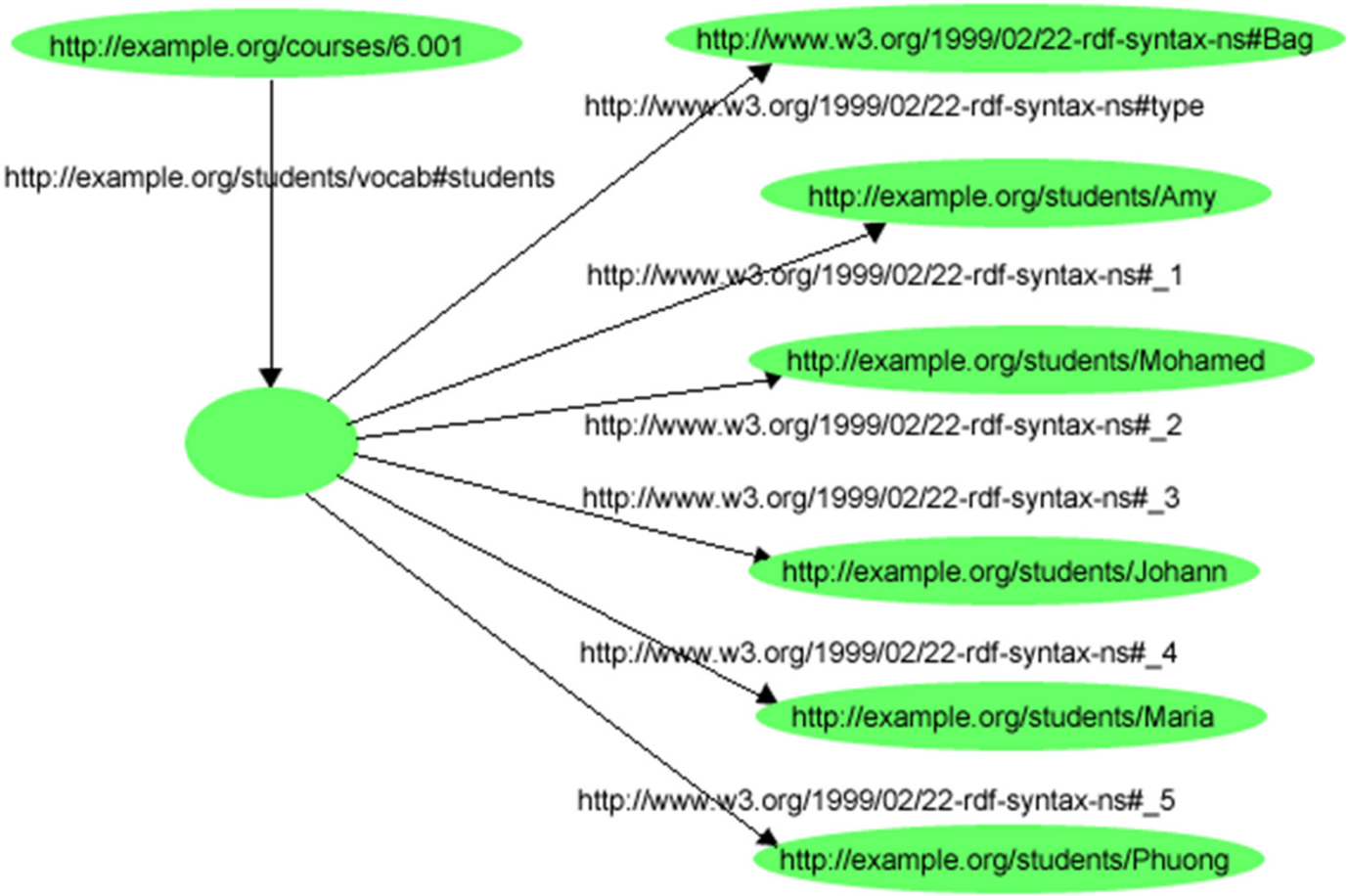
I can query for the mailbox of Eric Miller, without knowing a priori if he uses mailbox or email …
… if Eric Miller will change mailbox, serach result will be coherent!

RDF - Examples



Empty Nodes

RDF – Examples



Bags/Sets

RDF – Expressive Power

RDF supports:

- Types (classes) by means of the attribute type (that assume as value an URI)
- Subject/object of a sentence can be also collections (bag, sequence, alternative)
- *Meta-sentences*, through *reification* of teh sentences ("Marco says that Federico is the author of web page xy")

RDF Schema

- RDF can be intended also as a description of resource attributes and of the values of such attributes
- RDFS allows to describe classes and relations with other classes/resources
  - *type*
  - *subClassOf*
  - *subPropertyOf*
  - *range*
  - *domain*

RDF and E/R Models

- Many similarities with E/R models …
  - … RDF is more expressive
- RDF to be intended as the “E/R” for the web

- Relations in RDF are “first class entities”
- In RDF the list of properties of an entity is not:
  - A priori determined by the developer
  - Centralized (DB)
    - Consequence of the fact that any one can assert anything about any one else

RDF and Relational Databases

There is a direct mapping with relational db

- A record is viewed as a RDF node
- The name of a table column is viewed as rdf:propertyType
- The corresponding field value is intended as the value of the property
- RDF aims to integrate different databases with different underlying model
  - Traditional DBMS are optimized for creating new data models within the same db or within a restricted set of dbs

RDF Framewroks

- JENA, Java framework for representing and managing RDF statements

- SPARQL, Query language for RDF Repository, that supports graph navigation also to different/distributed rdf repositories
  - Agnostic w.r.t. Implementation

RDF Tools

Many tools already available …

Only in the W3C wiki there are citations for:

- 25 Frameworks/reasoners
- 27 RDF Triple Stores

Have a look to

http://www.w3.org/2001/sw/wiki/Tools

RDFa

- RDFa is a specification for attributes to express structured data in XHTML.
- The rendered, hypertext content of XHTML is reused by the RDFa markup
  - publishers don't need to repeat significant data in the document.

Source: RDFa Primer
http://www.w3.org/TR/2008/NOTE-xhtml-rdfa-primer-20081014/

RDFa

```
…
All content on this site is licensed under
<a href="http://creativecommons.org/licenses/by/3.0/">
        a Creative Commons License
</a>.
```

```
…
All content on this site is licensed under
<a rel="license" href="http://creativecommons.org/licenses/by/3.0/">
        a Creative Commons License
</a>.
```

This page has a relation of type license with the page at creative commons...

Source: RDFa Primer
http://www.w3.org/TR/2008/NOTE-xhtml-rdfa-primer-20081014/

RDFa

```
…
<div>
        <h2> The trouble with Bob </h2>
        <h3> Alice </h3>
        ...
</div>
```

```
<div xmlns:dc="http://purl.org/dc/elements/1.1/">
        <h2 property="dc:title"> The trouble with Bob </h2>
        <h3 property="dc:creator"> Alice </h3>
        ...
</div>
```

Note the reference to the DC namespace, i.e. the Dublin Core initiative
http://dublincore.org/

Source: RDFa Primer
http://www.w3.org/TR/2008/NOTE-xhtml-rdfa-primer-20081014/

GRDDL

- GRDDL is a mechanism for **G**leaning **R**esource **D**escriptions from **D**ialects of **L**anguages.
- A technique for obtaining RDF data from XML documents and in particular XHTML pages.
- Authors may explicitly associate documents with transformation algorithms, typically represented in XSLT, using a link element in the head of the document.

Source: GRDDL Primer
http://www.w3.org/TR/2007/NOTE-grddl-primer-20070628/
http://www.w3.org/2001/sw/wiki/GRDDL

POWDER

- POWDER — the Protocol for Web Description Resources — provides a mechanism to describe and discover Web resources and helps the users to make a decision whether a given resource is of interest.
- There are a variety of use cases: from providing a better means to describing Web resources and creating trustmarks to aiding content discovery, child protection and Semantic Web searches.

Source: GRDDL Primer
http://www.w3.org/TR/2009/NOTE-powder-primer-20090901/

RIF

- RIF defines a standard for exchanging rules among rule systems, in particular among Web rule engines.
- RIF focuses on exchange rather than defining a single one-fits-all rule language
  - a single language would not cover all popular paradigms of using rules for knowledge representation and business modeling.

Source: RIF W3C Activity
http://www.w3.org/2001/sw/wiki/RIF

SAWSDL

- SAWSDL defines a set of extension attributes for the Web Services Description Language and XML Schema definition language that allows description of additional semantics of WSDL components.
- The specification defines how semantic annotation is accomplished using references to semantic models, e.g. ontologies.
- Semantic Annotations for WSDL and XML Schema (SAWSDL) does not specify a language for representing the semantic models ...
  - it provides mechanisms by which concepts from the semantic models, typically defined outside the WSDL document, can be referenced from within WSDL and XML Schema components using annotations.

Source: SAWSDL W3C Working group
http://www.w3.org/2001/sw/wiki/SAWSDL

SPARQL

- SPARQL can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware.
- SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions.
- Supports extensible value testing and constraining queries by source RDF graph.
- The results of SPARQL queries can be results sets or RDF graphs.

Source: SPARQL W3C Working group
http://www.w3.org/2001/sw/wiki/SPARQL
http://www.w3.org/TR/2008/REC-rdf-sparql-query-20080115/

SPARQL

Data:

```
<http://example.org/book/book1>
   <http://purl.org/dc/elements/1.1/title>
"SPARQL Tutorial" .
```

Query:

```
SELECT ?title
   WHERE { <http://example.org/book/book1>
           <http://purl.org/dc/elements/1.1/title>
           ?title .
   }
```

Source: SPARQL W3C Working group
http://www.w3.org/2001/sw/wiki/SPARQL
http://www.w3.org/TR/2008/REC-rdf-sparql-query-20080115/

Ontology Web Language (OWL)

- Standard W3C
- Based upon/extend RDF/RDFS
- Formal Semantics (*Description Logic Fragments*)
- Three level of espressivity/complexity
  - OWL Lite
  - OWL DL
  - OWL Full

OWL – Features

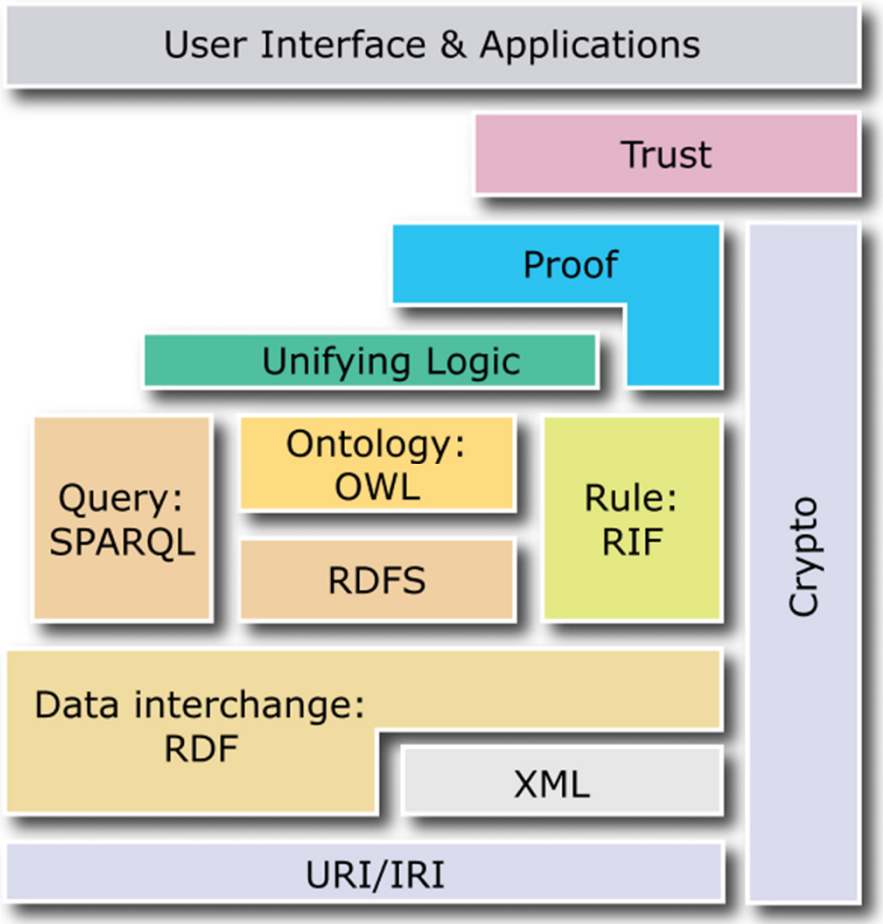
- Classes (categories): subClassOf, intersectionOf, unionOf, complementOf, enumeration, equivalence, disjoint
- Properties (Roles, Relations): symmetric, transitive, functional, inverse Functional, range, domain, subPropertyOf, inverseOf, equivalentProperty
- Instances (Individuals): sameIndividualAs, differentFrom, allDifferent

OWL Tools

- Many tools for OWL
  - Editors (19 listed at http://www.w3.org/2001/sw/wiki/Category:Editor)
  - Reasoners (24 listed at http://www.w3.org/2001/sw/wiki/Category:Reasoner)
- Quite often integrated in a comprehensive framework

A well known (but not necessarily the best one) ontology editor:
Protégé http://protege.stanford.edu/

The Semantic Web Cake



Semantic Web: where are we?

Semantic Web – which problems?

- SW has been officially proposed in 2001 ...
- … it has not transformed the web (yet!)
  - A lot of research about in the academic world
  - A bit less interest in the industrial world
    - Recently, some interest for Semantic Web Services
- Roughly speaking, “it is difficult to understand the benefits”

Semantic Web – which problems?

- RDF adoption
  - Adding semantic content is expensive
  - Until a critical mass of semantic content is available on the web … SW tools fail to convince.
  - W3C answer: many proposals in such directions
    - *Gleaning Resource Descriptions from Dialects of Languages* – GRDDL
    - RDFa with HTML5
- Ontologies
  - To produce a new one is highly expensive and time-demanding
  - An ontology is “alive”, it changes in time
    - Updating costs
    - Managing costs

Semantic Web – critics?

- It cannot be done practically ... ?????
  - Metacrap problem
  - Wrong content (introduce with some bad purpose)
- Which use of the data?
  - Censorship problems & freedom
  - Privacy problems
- Data are already available on the web, it is sufficient to extract them
  - SW is not useful ???? But how to extract, and then represent data?
  - Mashups show some interesting results

Semantic Web – critics?

- Computationally expensive
  - … but the adoption of a fragment of Description Logic is an answer
  - … maybe we don’t need in every application all the expressive power…

Concluding...

- Semantic Web: adding semantic information to web resources (data and whatever)
- Big perspectives …
- … we start seeing the results after 9 years, but no revolution has been really achieved yet

Concluding...

- Instead of Semantic Web, we should use the term Data Web (Berners-Lee)
- From the focus on the reasoning …
- … to the data, and especially the re-use of a big amount of data already available in the web

Few considerations (personal) ...

- Who is responsible to add semantic content on the web?
  - Single users (authors)
    - Metacrap ☹
    - Folksonomies (e.g. flickr) ☺
    - Wikis ☺
  - Industry firms
    - They already have huge data collections, more or less organized ...
    - ... why they should share their knowledge?
    - Global market extremely hard and difficult... Knowledge is a key to competitive advantage in the Porter chain...

Few considerations (personal) ...

- Cultural issues ...
  - Not in all country there is such a desire of sharing information

- SW really appealing in a intra-business scenario
- Few doubts in a inter-business scenario
  - *Bussiness secrecy, NDA, and other commercial practices*
  - Usually, a firm wants to have a complete control over its data
    - Which data tio publish?
    - Who is using them (competitors?)
    - What are they doing with our data?

Few links to start with…

Official site W3C:

- http://www.w3.org/2001/sw/

Communities:

- http://www.semanticweb.org/
- http://www.websemantico.org/

Thanks for the attention

Questions?

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