Egyptian E-Learning University (EELU)
Faculty of Computers and Information Technology

The Web Engineering 3

Introduction to Semantic Web

Lecture 4

Semantic Web Technologies and Layered Approach (Cont.)

Presented by
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Course Topics

- Introduction to the semantic web.
- Semantic web technologies and layered approach.
- Structured web documents in XML.
- Describing web resources in basic elements of Resource Description Framework (RDF).
- Web Ontology Language: OWL.
- Ontologies Applications.

Course References

1. Grigoris Antoniou, Paul Groth, Frank van Harmelen, Rinke Hoekstra, "A Semantic Web Primer", 2012.
2. John Domingue, Dieter Fensel, James A. Hendler, "Introduction to the Semantic Web Technologies", 2011.

Lecture 4 Outlines

- Current Web Technologies and their Problems.
- What is the solution?
- Design Principles of the Semantic Web.
- Semantic Web Technologies.
  - Semantic Web Structure and layers.
  - Ontologies.
    - Ontologies definition.
    - Components of Ontologies.
    - Ontologies Languages.
      - ✓ RDF Schema.
      - ✓ OWL .
- Semantic Web Agents.

Ontologies

- **Ontology:** is a set of knowledge terms, including the vocabulary, the semantic interpretations, and some simple rules of inference for a particular topic.

- **Ontology:** is the basic structure format around which a knowledge base can be built.

- **Ontology:** is a clear shared formal specification of a conceptualization.

The Concept of ontology

- **Ontology meaning** => shared conceptualization of a domain of interest as knowledge not just a data.
- **Shared vocabulary** => simple and clear ontology or description of relations between data.
- **Descriptions**: describes (complex) relationships between "terms" => called deep ontology.
- From AI view:
  - ontology = logical theory (to build knowledge base)
- DB view:
  - ontology = conceptual model for existing DB

Web Ontology Languages

1 RDF Schema:

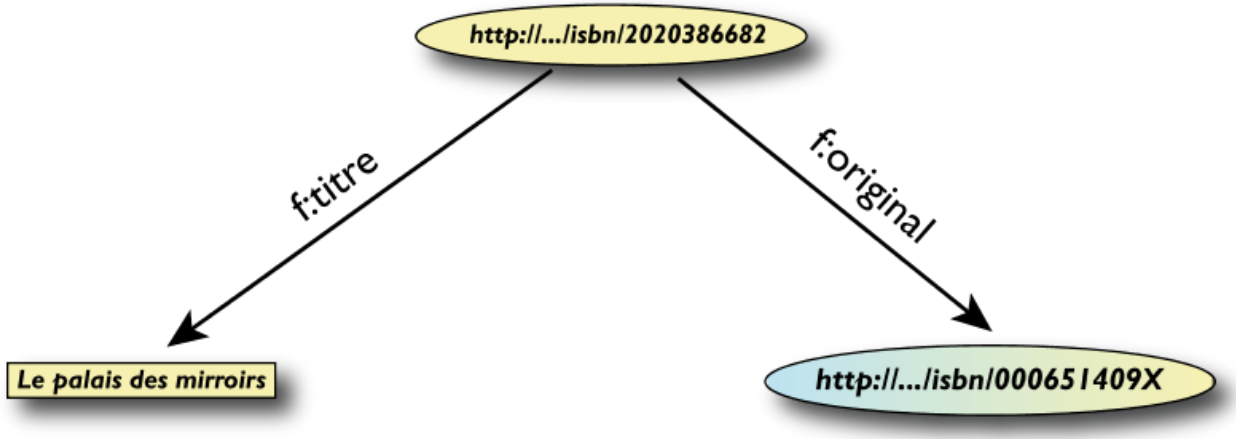
- RDF Stands for “Resource Description Framework”.
- RDF is a data model for representing data objects and principles of relations between them.
- RDF Schema is a vocabulary description language.
- Describes properties and classes of RDF resources.
- RDF Schema built based on the structure of RDF resources (triples).
- These resources can be saved in triple stores to reach them with different query languages such as SPARQL.

SPARQL and RDF Query Language: enables users to query information from databases or any data source that can be mapped to RDF. The SPARQL standard is designed and developed by the W3C and helps users and developers focus on what they would like to know instead of how a database is organized.

Web Ontology Languages

1 RDF Schema:

- A triple store or RDF store is a purpose-built database for the storage and retrieval of triples. [do not forget that triple means statement]
  - Resources can use *any* URI, *e.g.*:
    - **http://www.example.org/file.xml#element(home)**
    - **http://www.example.org/file.html#home**
    - **http://www.example.org/file2.xml#xpath1(//q[@a=b])**




```
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</rdf:Description>
```

Web Ontology Languages

2- OWL:

- OWL stands for Web Ontology Language.
- It is a semantic markup language for publishing and sharing ontologies on the World Wide Web.
- It is a vocabulary extension of RDF (the Resource Description Framework) relations between classes.
- Richer typing of properties.
- Characteristics of properties.

Full description about the relationships properties

Ontologies: example

```
class-def animal                                % animals are a class
class-def plant                                 % plants are a class
    subclass-of NOT animal                      % that is disjoint from animals
class-def tree
    subclass-of plant                           % trees are a type of plants
class-def branch
    slot-constraint is-part-of                  % branches are parts of some tree
        has-value tree
        max-cardinality 1

class-def defined Lion                          % lion are animals
    subclass-of animal
    slot-constraint eats                        % that eat any other animals
        value-type a wild animal

   class-def defined Goat                       % Goat are animals
      subclass-of animal, NOT Lion              % that are not Lion, and
      slot-constraint eats                      % they eat plants or parts of plants
          value-type a pet animal
```

Ontologies: the role of logic

- Well-established correspondence between conceptual modeling formalisms and logic modeling.
  - Application specific declarative knowledge.

The Ontology Layer Abstraction

Ontology = shared conceptualization

⇒ conceptual model

(more expressive than RDF + RDFS)

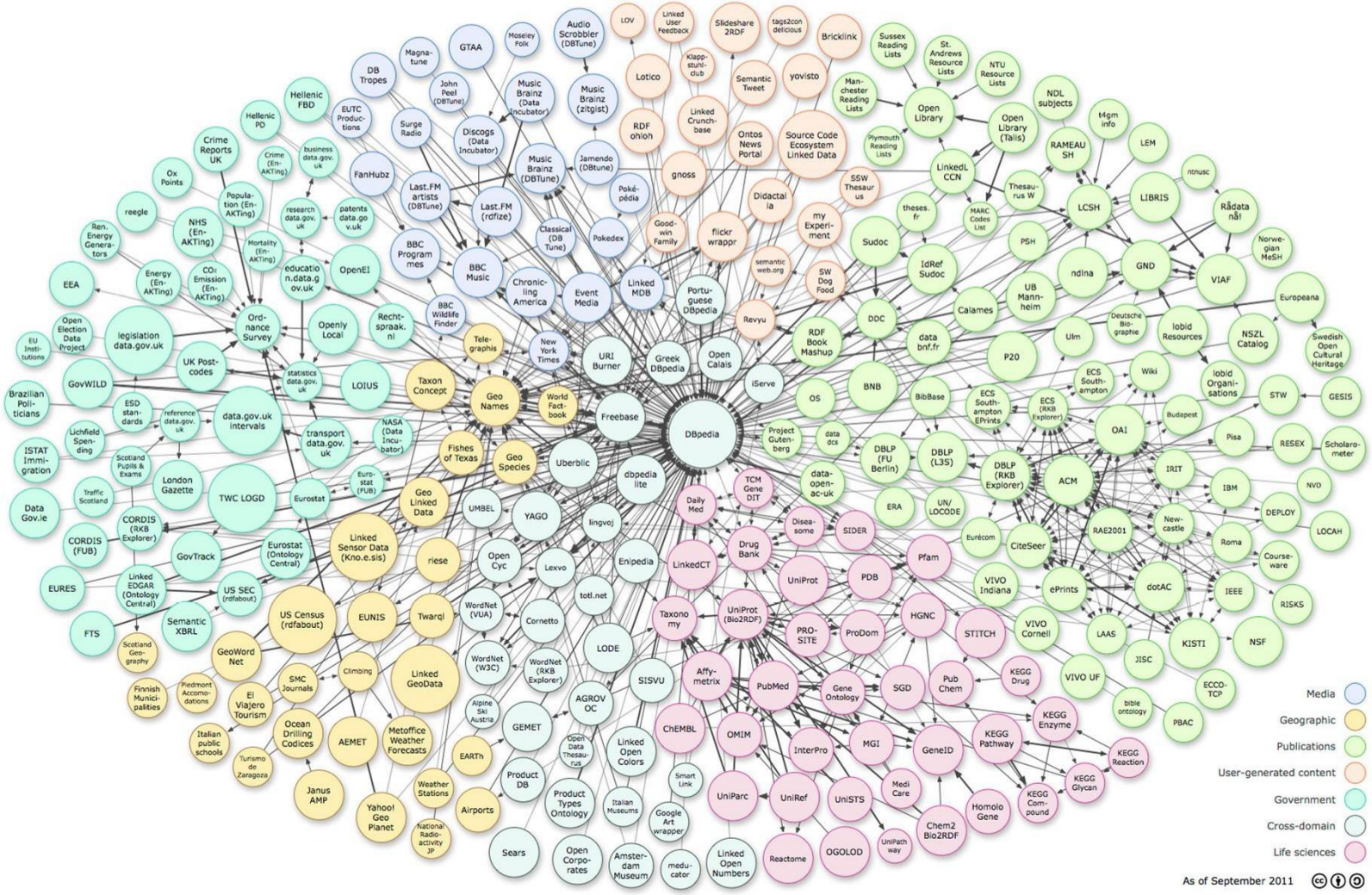
⇒ expressed in a true knowledge representation language

OWL (Web Ontology Language) = standard language for ontologies

Ontologies and Description Logics

- **Description Logics (DLs):** are one of the most usable languages for Knowledge Representation (used for writing ontologies)
- **OWL** is based on a segmentation (fragment) of First-Order object Logic (FOL)
- Description Logics (DLs) = subclasses of FOL
  - only single and binary objects.
  - Function free
  - quantification (scale measurements) allowed only in restricted form
  - (variable-free syntax)
  - Reasoning: take decision bout data linking (final decision about data linking)

The Semantic Web in the real world

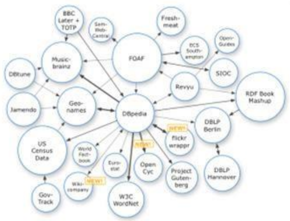


Linking Open Data cloud diagram, 09/2011 (by Richard Cyganiak and Anja Jentzsch. http://lod-cloud.net/)

What is Linked Data?

- **Linked Data**: recommend best connection for exposing, sharing, and connecting pieces of data (terms), information, and knowledge on the Semantic Web using URIs and RDF.
- **Linking Open Data (LOD)**: The goal of the W3C Linking Open Data community project is to **extend the Web with a data commons by publishing various open data sets as RDF on the Web** and by **setting RDF links between data items from different data sources**.
- RDF links enable you to navigate from a data item within one data source to related data items within other sources using a Semantic Web browser.
- As query results are structured data and not just links to HTML pages, they can be used within other applications."

The LOD cloud diagram



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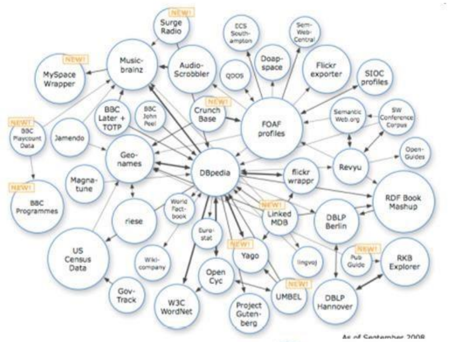

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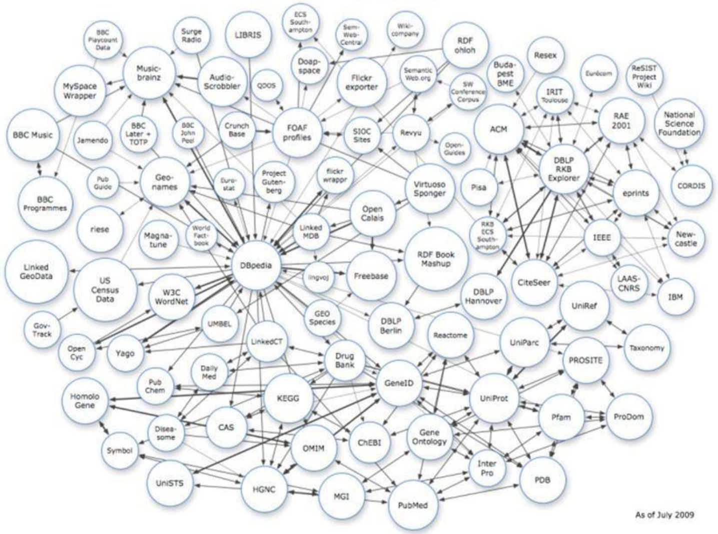

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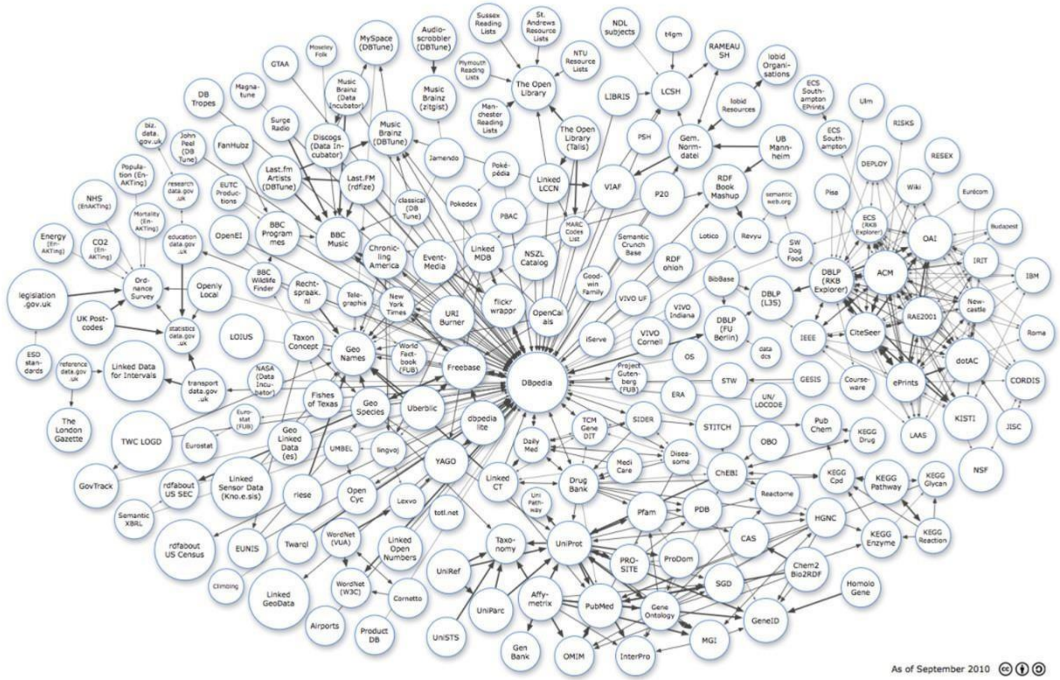
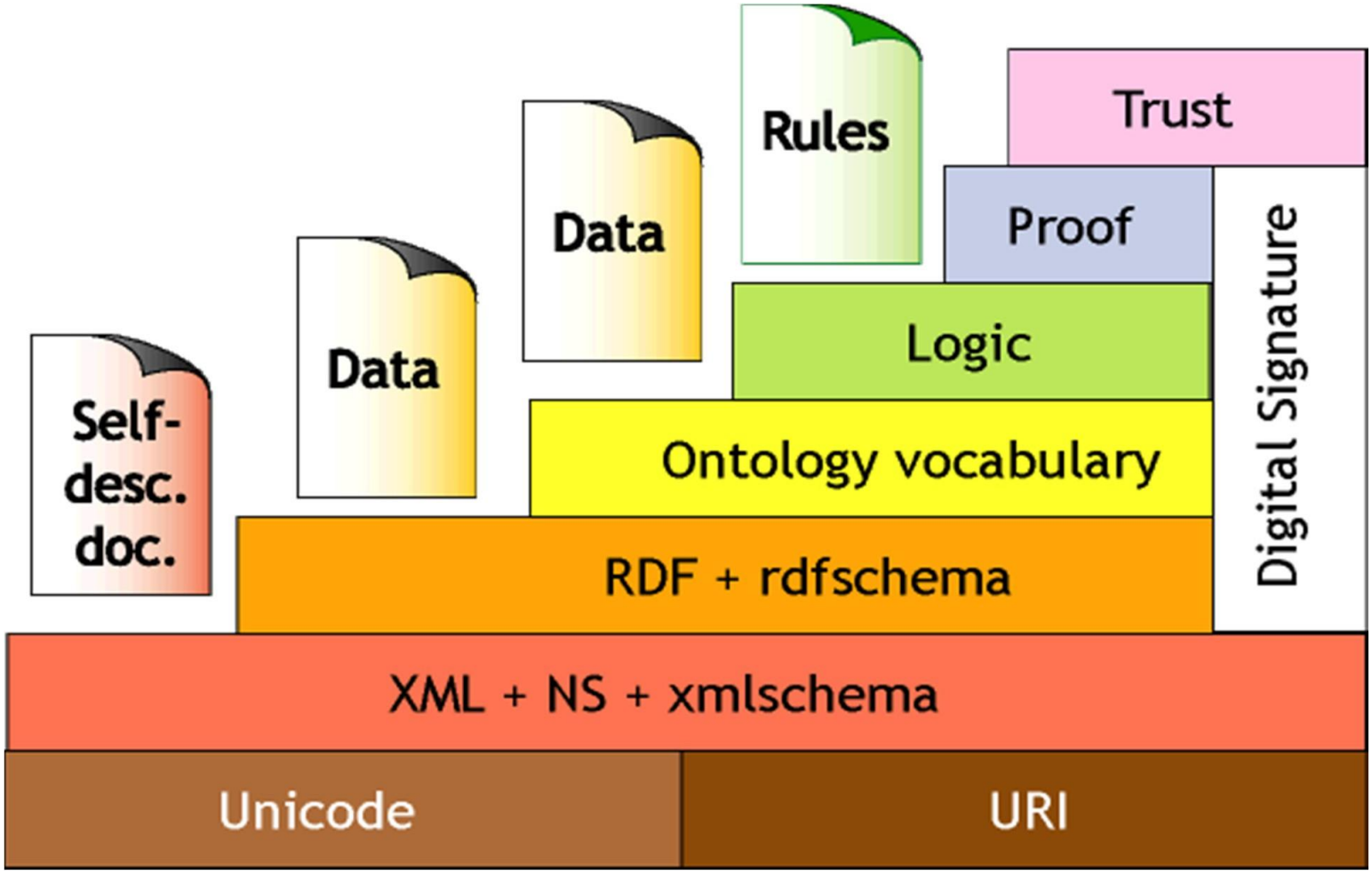


9/ 2010

The Semantic Web Structure

- The development of the Semantic Web proceeds in steps.
- Each step building a layer on top of another.



Thank you

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