

## Semantic Web Technologies

### Review of Course Material

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1/23

## Outline

Ontologies

RDF(S)

SPARQL

OWL

F-Logic

FOAF, GRDDL, and Information Integration

Semantic Web Services

2/23

## Main Aspects

- ▶ Two ways of defining ontologies
  - ▶ Conceptual: a formal specification of a shared conceptualization
  - ▶ Elements of an ontology: concepts, relations, axioms, instances

4/23

## Key Material

- ▶ **Slides!** lecture 1
- ▶ Ontology Development 101: [http://protege.stanford.edu/publications/ontology\\_development/ontology101-noy-mcguinness.html](http://protege.stanford.edu/publications/ontology_development/ontology101-noy-mcguinness.html)
- ▶ Recommended: Jos de Bruijn: Using Ontologies. DERI-TR-2003-10-29, 2003. <http://www.deri.org/publications/techpapers/documents/DERI-TR-2003-10-29.pdf>

5/23

## Main Aspects

- ▶ RDF as a graph vs. RDF as a logical theory
- ▶ RDF, RDFS vocabularies
  - ▶ RDF Containers
  - ▶ RDFS meta-data properties
- ▶ RDFS as lightweight ontology language
- ▶ Semantic notions: subgraph, instance, entailment
- ▶ RDF simple entailment
  - ▶ If  $S'$  is an instance and  $S''$  is a subgraph of  $S$ , then  $S' \models_{\text{simple}} S''$
  - ▶ Intuitively, subgraph matching with bNodes as existential variables
- ▶ RDFS entailment
  - ▶ Axiomatic triples
  - ▶ RDFS Semantic Conditions (not necessary to know by heart)
- ▶ Syntaxes
  - ▶ write **Turtle**
  - ▶ read RDF/XML

7/23

## Key Material

- ▶ **Slides!** lectures 1,2,9
- ▶ RDF Primer: <http://www.w3.org/TR/rdf-primer/>
- ▶ Resource Description Framework Definition: <http://www.inf.unibz.it/~jdebruijn/teaching/swt/rdf.pdf>
- ▶ Recommended: RDF Semantics, Chapters 1,2,4: <http://www.w3.org/TR/rdf-mt/>

8/23

## Main Aspects

- ▶ Kinds of sparql queries
  - ▶ select, construct, ask
- ▶ Syntax of a select query
  - ▶ Basic, optional graph patterns, filters
- ▶ Query answers
- ▶ E-entailment regimes
- ▶ Basic Graph Pattern Matching

10/23

## Key Material

- ▶ **Slides!** lecture 3,4
- ▶ Jena SPARQL tutorial:  
<http://jena.sourceforge.net/ARQ/Tutorial/>
- ▶ Consult spec if anything unclear!  
<http://www.w3.org/TR/rdf-sparql-query/>

11/23

## Main Aspects

- ▶ OWL as more expressive ontology language
- ▶ Features of OWL
- ▶ Species of OWL: Lite, DL, Full
- ▶ OWL Lite/DL as Description Logic
- ▶ Layering issues with RDF(S)
- ▶ Layering of OWL species
- ▶ Description Logic Programs
  - ▶ Checking whether an OWL ontology is in this fragment
  - ▶ Considerations on expressiveness

13/23

## Key Material

- ▶ **Slides!** lecture 5,6,9
- ▶ OWL Guide: <http://www.w3.org/TR/owl-guide/>
- ▶ Jos de Bruijn. Logics for the semantic web. In Semantic Web Services: Theory, Tools and Applications. IDEA Publishing, 2007. Sections 2 and 3. <http://www.debruijn.net/publications/deri-tr-2006-06-03.pdf>
- ▶ Ian Horrocks, Peter F. Patel-Schneider, and Frank van Harmelen. From SHIQ and RDF to OWL: The making of a web ontology language. **Journal of Web Semantics**, 1(1):7, 2003.

14/23

## Main Aspects

- ▶ F-Logic (Programming) as Ontology and Rules language
- ▶ F-Logic syntax as explained on slides
- ▶ Quantification over class, attribute names
- ▶ F-Logic Semantics, key aspects
  - ▶ Indirection in interpreting classes, individuals
  - ▶ Relating individuals in domain with subsets (classes), functions (attributes)
- ▶ Encoding RDF in F-Logic
  - ▶ Possible issue with bNodes if skolemized
- ▶ Differences with OWL (DL)
  - ▶ Differences DL, LP
  - ▶ :: vs.  $\sqsubseteq$

16/23

## Key Material

- ▶ **Slides!** lecture 7,8,9
- ▶ Michael Kifer: Rules and Ontologies in F-Logic. Reasoning Web 2005: 22-34
- ▶ Jos de Bruijn. Logics for the semantic web. In Semantic Web Services: Theory, Tools and Applications. IDEA Publishing, 2007. Sections 4 and 5. <http://www.debruijn.net/publications/deri-tr-2006-06-03.pdf>

17/23

## Main Aspects

- ▶ FOAF as RDF vocabulary for specifying social networks
- ▶ Extracting RDF from HTML/XML
  - ▶ Including RDF as comments
  - ▶ Linking to external file
  - ▶ Using GRDDL: Associating transformations with
    - ▶ Types of documents
    - ▶ Individual documents
- ▶ Basic information integration scenario (global-as-view)
  - ▶ Databases, connected to
  - ▶ single global ontology, with
  - ▶ additional constraints

19/23

## Key Material

- ▶ **Slides!** lecture 10
- ▶ E. Dumbill: XML Watch: Finding friends with XML and RDF, 2002.  
<http://www-128.ibm.com/developerworks/xml/library/x-foaf.html>
- ▶ GRDDL:  
<http://www.idealliance.org/proceedings/xttech05/papers/03-06-01/>
- ▶ H-P. Schnurr, J. Angele: Automotive Industry Experience with Semantic Guides. ISWC 2005: 1029-1040.  
[http://dx.doi.org/10.1007/11574620\\_73](http://dx.doi.org/10.1007/11574620_73)

20/23

## Main Aspects

- ▶ Problems with current Web Services technologies
  - ▶ advertising, discovery, selection, composition, ...
- ▶ Semantic Description of Service
  - ▶ Functional Description
    - ▶ **coarse-grained**, DL-style categorization
    - ▶ **fine-grained**, precondition/effect(postcondition)
  - ▶ Non-functional properties
- ▶ Notions of matching for DL-based discovery
  - ▶ exact, plugin, subsume, intersection, disjoint
- ▶ Web Service Modeling Ontology
  - ▶ Ontologies, Goals, Web services, Mediators
  - ▶ usage process

22/23

## Key Material

- ▶ **Slides!** lecture 11
- ▶ J. de Bruijn, D. Fensel, U. Keller, and R. Lara. Using the web service modelling ontology to enable Semantic eBusiness. Communications of the ACM, special issue on the semantic e-business vision, 48(12):43-47, December 2005.  
<http://www.debruijn.net/publications/wsmo-cacm-ebusiness.pdf>
- ▶ Recommended: S. McIlraith, T.C. Son, H. Zeng: Semantic Web Services, in IEEE Intelligent Systems, Special Issue on the Semantic Web, 16(2): 46-53, March/April 2001.
- ▶ Recommended: L. Li, I. Horrocks: A Software Framework For Matchmaking Based on Semantic Web Technology, in WWW2003.

23/23