COURSE DESCRIPTION

Introduction to Semantic Web concepts and applications, focusing on the Resource Description Framework (RDF), RDF Schema, Ontologies, and Web Ontology Language (OWL).

- Many industries, businesses, biological and human science, health care, government, and other information agencies today use Semantic Web (SW) technologies such as RDF, RDFS, ontologies, and OWL to organize, manage, and provide rich user access to their complex information assets. The Dublin Core Metadata Initiative has moved entirely into an RDF/SW environment, and the Library of Congress and other national libraries have now committed to transitioning from MARC into an RDF/SW bibliographic framework, and they have already published their metadata elements and vocabularies in RDF / SKOS, including those of the new Resource Description and Access (RDA) cataloging code. Semantic Web technologies are the way of the future for library bibliographic data, Dublin Core and other metadata schemes, and many other types of information organization applications. Librarians, catalogers, metadata specialists, taxonomists, ontologists, and students preparing for careers in these fields have a growing interest in, and need to learn about, these topics.

- Among many differing viewpoints and understandings of the "Semantic Web," one approach is to view the term as referring to both a set of technologies and a method of transforming selected portions of the current World Wide Web into a web of structured, linked data that can be queried like a database, in contrast with the current web of linked documents that can be queried by text string matching and relevance ranking algorithms. SW technologies also allow machines to make logical inferences that have not been explicitly stated by human beings. The Semantic Web has been called Web 3.0 in contrast to Web 2.0.

- The Resource Description Framework (RDF) is a data model for structuring metadata in a simple, nonproprietary, machine-readable syntax that facilitates linking data from diverse resources across the Web. Ontologies are formal models of classes of resources in a given domain, the properties of those resources, and constrains on the relationships among them, allowing for structured information, machine inferencing, and rich user querying. RDF Schema (RDFS) adds layers of expressivity to simple RDF that allow for the creation such ontologies. Web Ontology Language (OWL) adds yet richer levels of detail that allow for even more powerful data modeling, inferencing, and querying. Simple Knowledge Organization System (SKOS) is a simpler subset of OWL for encoding existing knowledge organization systems (controlled vocabularies) and their semantic relationships.

- This course provides a beginner's level introduction to, and overview of, the topics covered. The course is intended for those who have no computer science or programming background. The central focus is on creating ontologies as a form of information and knowledge organization in a Semantic Web / Linked Web of Data environment.

PREREQUISITES

Required:
Successful completion of L&I SCI 511 Organization of Information.

Basic computer literacy as outlined in the SOIS policy: [http://www.uwm.edu/Dept/SOIS/academics/MLIS/mliscomplit.htm](http://www.uwm.edu/Dept/SOIS/academics/MLIS/mliscomplit.htm).


**Recommended as useful, but not required:**

- Completion of L&I SCI 571 (Information Access and Retrieval) and/or 714 (Metadata).
- Some familiarity with database design, XML, and XML technologies.

**OBJECTIVES**

Upon completion of the course, students will be able to:

1. Articulate the meaning of the “Semantic Web,” how it differs from the non-semantic Web, the basic components of Semantic Web technologies, and how such technologies are being used in current applications;
2. Explain and create examples of the structures of the Resource Description Framework data model, including triples, statements, literals, typed literals, and URIs;
3. Express RDF as graphs and in RDF XML syntax, and be able to view and understand other RDF serialization syntaxes such as Turtle and N-triples;
4. Articulate the meaning of semantic modeling, “ontologies,” and their components and structures;
5. Create ontologies in RDFS, including classes and subclasses, properties and subproperties, domains and ranges, instances, and facets, and determine resulting inferencing and querying capabilities;
6. Determine when and why an ontology would be useful in a particular context, what it can accomplish, what inferences it can allow computer systems to make, and what user queries it can answer;
7. Use the Protégé ontology editing software to create a machine-readable ontology;
8. Express existing traditional knowledge organization systems such as taxonomies, classification schemes, and thesauri in SKOS RDF XML;
9. Understand the differences between RDFS and OWL (Web Ontology Language) and the increased expressiveness and inferencing capabilities of OWL;
10. Define property characteristics in OWL, such as symmetric, transitive, functional, inverse, and inverse functional properties, and how they increase the inferencing power of an ontology;
11. Create / engineer an ontology in OWL for a specific practical application;
12. Explain the significance of existing Semantic Web applications and domain ontologies, including Linked Library Data, RDA Vocabularies in SKOS, Library of Congress authorities and vocabularies in SKOS, the Dublin Core Abstract Model and Dublin Core metadata ontology, FOAF, and the like.

*Students with special needs should contact me as early as possible for accommodations.* See the policies at the end of this syllabus.

**COURSE READINGS AND RESOURCES**

**Required Textbook:**


**Additional Required Readings:**

RDF, Ontologies, and the Semantic Web


Additional Useful Textbook (Not Required):


Online Resources, Examples, and Use Cases:

BBC Programmes Ontology: http://purl.org/ontology/po/

BBC Wildlife Ontology: http://purl.org/ontology/wo/

DBpedia: http://dbpedia.org/About


DCMI Metadata Terms: http://dublincore.org/documents/dcmi-terms/

Freebase: http://www.freebase.com/


Library Linked Data Incubator Group: Use Cases: http://www.w3.org/2005/Incubator/lld/XGR-lld-usecase-20111025/
Library of Congress Authorities and Vocabularies (in RDF/LCOS): \texttt{http://id.loc.gov/}

Linked Data website: \texttt{http://linkeddata.org/}

Open Library: \texttt{http://openlibrary.org/}

Protégé Ontology Library: \texttt{http://protegewiki.stanford.edu/wiki/Protege_Ontology_Library}

RDA (Resource Description and Access) Vocabularies (in RDF/SKOS): \texttt{http://rdvocab.info/}

Sporny, Manu. 2007. “Introduction to the Semantic Web.” YouTube. \texttt{http://www.youtube.com/watch?v=OGg8A2zfWkg}


Tauberer, Joshua. [2008.] "Quick Intro to RDF" RDF: About. \texttt{http://www.rdfabout.com/quickintro.xpd}


The Bibliographic Ontology (BIBO): \texttt{http://bibliontology.com/}

VIVO: \texttt{http://vivoweb.org/}

VIAF: The Virtual International Authority File: \texttt{http://viaf.org/}


WordNet: \texttt{http://wordnet.princeton.edu/}

XC EXtensible Catalog: \texttt{http://www.extensiblecatalog.org/}

\textbf{Official W3C Standards Information and Resources:}

- W3C Semantic Web website: \texttt{http://semanticweb.org/wiki/Main_Page}
- W3C Resource Description Framework (RDF): \texttt{http://www.w3.org/RDF/}
- W3C Semantic Web: "Ontology:" \texttt{http://semanticweb.org/wiki/Ontology}
- W3C Web Ontology Language (OWL): \texttt{http://www.w3.org/2004/OWL/}
- W3C SKOS Simple Knowledge Organization System: \texttt{http://www.w3.org/2004/02/skos/}

\textbf{COURSE SCHEDULE}

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Required Readings</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to the Semantic Web and Linked Data Visions, including Linked Library Data</td>
<td>Antoniou/Harmelen Ch. 1; Berners-Lee et al.; Bizer et al; Baker et al.; [Allemang/Hendler Ch. 1]</td>
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<td></td>
<td>Structured Web Documents: XML</td>
<td>Antoniou/Harmelen Ch. 2; Johnston</td>
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<td>2</td>
<td>Describing Web Resources in RDF (Resource Description Framework); Expressing RDF as graphs and in RDF XML</td>
<td>Antoniou/Harmelen Ch. 3.1-3.3 (p.65-84); Stewart 170-187; Berners-Lee 2006; Powell et al.; Coyle-Bib; [Allemang/Hendler Ch. 3]</td>
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<tr>
<td>3</td>
<td>Semantic Modeling and Ontologies; RDF Schema (RDFS); Classes, Properties, Domains, Ranges, Data Types</td>
<td>Antoniou/Harmelen Ch. 3.4-3.7 (p.84-102); Stewart 187-192; 161-170; DCMI-Terms [Allemang/Hendler Ch. 2]</td>
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\textit{June 10 Assignment 1: Create a set of related RDF triples as graphs and as RDF XML. Due June 10}
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
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<tbody>
<tr>
<td>4 Jun 18-24</td>
<td>Ontology creation; determine needs, domain, uses of ontology; Protégé-Frames Ontology Software</td>
<td>Noy &amp; McGuinness; Sachs</td>
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<tr>
<td>5 Jun 25-Jul 1</td>
<td>RDF Schema (RDFS); Semantic Web Application Architectures; RDF, Inferencing, and Querying; SPARQL</td>
<td>Antoniou/Harmelen Ch. 3.8-3.10 (p.102-110); [Allemang/Hendler Ch. 5, 6 &amp; 7]</td>
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<tr>
<td><strong>July 1</strong></td>
<td>Assignment 2: Create a simple, beginning-level ontology in RDFS; explain inferencing and querying capabilities. Due July 1</td>
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<tr>
<td>6 Jul 2-8</td>
<td>SKOS: Simple Knowledge Organization System; FOAF; Linked Library Data, RDA Vocabularies</td>
<td>Allemang/Hendler Ch. 10; Coyle-RDA; [Allemang/Hendler Ch. 9]</td>
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<tr>
<td><strong>July 11</strong></td>
<td>Assignment 3: Express a set of reciprocally-related terms from a traditional knowledge organization system in SKOS. Due July 11</td>
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<tr>
<td>7 Jul 9-15</td>
<td>OWL: Web Ontology Language Introduction; Comparison with RDFS</td>
<td>Antoniou/Harmelen Ch. 4; [Allemang/Hendler Ch. 11]</td>
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<td></td>
<td>OWL Properties (Symmetric, Transitive, Functional, Inverse, Inverse Functional), Cardinality, Increased Inferencing Power</td>
<td>Antoniou/Harmelen Ch. 4; [Allemang/Hendler Ch. 8 &amp; 12]</td>
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<tr>
<td>8 Jul 16-22</td>
<td>Logic and Inference: Rules; Protégé-OWL Ontology Editor</td>
<td>Antoniou/Harmelen Ch. 5; Horridge</td>
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<td></td>
<td>Ontology Applications: Examples of Ontologies in Different Domains and the Problems They Solve</td>
<td>Antoniou/Harmelen Ch. 6; [Allemang/Hendler Ch. 13]</td>
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<tr>
<td><strong>July 22</strong></td>
<td>Paper: Write an 8-10 page paper on a topic related to the Semantic Web, RDF, or RDFS or OWL ontologies using at least three professional sources. Due July 22</td>
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<tr>
<td>9 Jul 23-29</td>
<td>OWL Ontology Creation and Engineering; Good and Bad Modeling Practices</td>
<td>Antoniou/Harmelen Ch. 7; [Allemang/Hendler Ch. 14 &amp; 15]</td>
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<tr>
<td>10 Jul 30-Aug 5</td>
<td>RDF, Ontologies, and Semantic Web: Conclusion and Outlook</td>
<td>Antoniou/Harmelen Ch. 8; Anderson &amp; Rainie; [Allemang/Hendler Ch. 16]</td>
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<tr>
<td><strong>August 5</strong></td>
<td>Assignment 4: Final Project: Create a more complex OWL ontology for a given domain to solve a set of information problems; explain inferencing, querying, and benefits for users in the domain. Due August 5</td>
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Abbreviated citations to required readings in this schedule refer to complete citations given in the list of readings.

**EVALUATION**

<table>
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<td>Class Participation</td>
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<td>Assignment 1</td>
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<td>Assignment 2</td>
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<td>Assignment 3</td>
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<td>Paper</td>
<td>10%</td>
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<tr>
<td>Assignment 4: Final Project</td>
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<tr>
<td>Total</td>
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Rev. 12/7/2011
For students in the Information Organization (IO) Concentration, a B is required to have this course count towards your IO requirements.

UWM AND SOIS ACADEMIC POLICIES

The following links contain university policies affecting all SOIS students. For graduate students, there are additional guidelines from the Graduate School (http://www.uwm.edu/Dept/Grad_Sch/StudentInfo/), including those found in the Graduate Student and Faculty Handbook: http://www.uwm.edu/Dept/Grad_Sch/Publications/Handbook/.

UWM Academic Policies: http://www4.uwm.edu/sois/resources/academic_policy.html
Grad School Policies & Procedures: http://www.graduateschool.uwm.edu/students/policies/
SOIS Appeals: http://www4.uwm.edu/sois/academics/MLIS/mlisappeals.htm

Students with disabilities. If you will need accommodations in order to meet any of the requirements of a course, please contact the instructor as soon as possible. Students with disabilities are responsible to communicate directly with the instructor to ensure special accommodation in a timely manner. There is comprehensive coverage of issues related to disabilities at the Student Accessibility Center (http://www.uwm.edu/Dept/DSAD/SAC/MainOffice.html), important components of which are expressed here: http://www.uwm.edu/Dept/DSAD/SAC/SACltr.pdf.

Religious observances. Students’ sincerely held religious beliefs must be reasonably accommodated with respect to all examinations and other academic requirements, according to the following policy: http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S1.5.htm. Please notify your instructor within the first three weeks of the Fall or Spring Term (first week of shorter-term or Summer courses) of any specific days or dates on which you request relief from an examination or academic requirement for religious observances.

Students called to active military duty. UWM has several policies that accommodate students who must temporarily lay aside their educational pursuits when called to active duty in the military (see https://www4.uwm.edu/current_students/military_call_up.cfm), including provisions for refunds, readmission, grading, and other situations.

Incompletes. A notation of “incomplete” may be given in lieu of a final grade to a student who has carried a subject successfully until the end of a semester but who, because of illness or other unusual and substantial cause beyond the student’s control, has been unable to take or complete the final examination or some limited amount of other term work. An incomplete is not given unless the student proves to the instructor that s/he was
prevented from completing course requirements for just cause as indicated above ([http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S31.pdf](http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S31.pdf)).

**Discriminatory conduct** (such as sexual harassment). UWM and SOIS are committed to building and maintaining a campus environment that recognizes the inherent worth and dignity of every person, fosters tolerance, sensitivity, understanding, and mutual respect, and encourages the members of its community to strive to reach their full potential. The UWM policy statement ([http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S47.pdf](http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S47.pdf)) summarizes and defines situations that constitute discriminatory conduct. If you have questions, please contact an appropriate SOIS administrator.

**Academic misconduct.** Cheating on exams and plagiarism are violations of the academic honor code and carry severe sanctions, ranging from a failing grade for a course or assignment to expulsion from the University. See the following document ([http://www4.uwm.edu/osl/dean/conduct.cfm](http://www4.uwm.edu/osl/dean/conduct.cfm)) or contact the SOIS Investigating Officer (currently the Associate Dean) for more information.

**Complaints.** Students may direct complaints to the SOIS Dean or Associate Dean. If the complaint allegedly violates a specific university policy, it may be directed to the appropriate university office responsible for enforcing the policy.

**Grade appeal procedures.** A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow SOIS appeals procedures or, in the case of a graduate student, the Graduate School. These procedures are available in writing from the respective department chairperson or the Academic Dean of the College/School ([http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S28.htm](http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S28.htm)).