Information Modeling

University of Illinois School of Information Sciences

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LIS561-LE
Spring 2017
Mondays, 5:30-7:30 PM, online
4 GR hours

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Course Description

An introduction to the foundations of information modeling methods used in current information management applications. The specific methods considered include relational database design, conceptual modeling, and ontologies. The basic concepts underlying these methods are sets, relations, entities, and logics. Applications considered include relational database design and RDF/OWL semantic web languages. Set theory and logic are emphasized as the foundational frameworks for information modeling in general, and for contemporary web-based information management and delivery systems (including semantic web technologies) in particular.

Pre- and Co-requisites

None.

Course Overview

Two sorts of students are anticipated and the course objectives are similar but slightly different for each group. In neither case is prior relevant knowledge assumed.

- LIS561 prepares students anticipating generalist responsibilities (as directors, managers, general staff, etc.) to be effective leaders in making decisions about the design, development, and evaluation of information systems, services, and policies, helping their organizations and communities deal with all aspects of the difficult technology challenges ahead.

- LIS561 prepares students anticipating careers as technology specialists to efficiently acquire and maintain superior information modeling skills throughout their careers and to play leadership roles in the design, development, and evaluation of information systems, services, and policies.

Consistent with the iSchool goal of producing leaders and not just competent professionals we focus on developing a deep understanding that will have long-term benefits and prepare students to engage the hardest problems facing organizations and society.

Of course LIS561 alone cannot fully realize these objectives; it makes a partial contribution, focusing on the principles and concepts of information modeling. A partial contribution, but a necessary one: the connection between a deep understanding of information modeling concepts and the challenging information management problems facing us today is profound.

Strategy

The course examines the major modeling approaches currently in use in information management: relational modeling, conceptual modeling, and ontologies, focusing on underlying concepts and principles. The course is thus simultaneously a foundations course and a survey course.

Learning Objectives

1. Develop fluency in reading and understanding formal definitions.
2. Understand the role of abstraction in making systems design choices.
3. Contrast deep vs. superficial differences in modeling languages.
4. Recognize practical implications of trading expressive power for tractability.
5. Appreciate the fundamental role of a very small set of inter-related concepts.

Course Materials

All required readings for this class are available online. They are listed in the references section at the end of this syllabus.

About Dave Dubin

David Dubin is a Research Associate Professor at the School of Information Sciences. His research explores the foundations of information representation and description as well as issues of expression and encoding in documents and digital information resources.

Library Resources

http://www.library.illinois.edu/lis/
lislib@library.illinois.edu
Phone: (217) 300-8439

Writing and Bibliographic Style Resources

The iSchool has a Writing Resources Moodle site https://courses.ischool.illinois.edu/course/view.php?id=1705 and iSchool writing coaches also offer free consultations. We highly recommend this!

The campus-wide Writers Workshop also provides free consultations. For more information see http://www.cws.illinois.edu/workshop/

Academic Integrity

Please review and reflect on the academic integrity policy of the University of Illinois, http://admin.illinois.edu/policy/code/article1_part4_1-401.html to which we subscribe. By turning in materials for review, you certify that all work presented is your own and has been done by you independently, or as a member of a designated group for group assignments. If, in the course of your writing, you use the words or ideas of another writer, proper acknowledgment must be given (using APA, Chicago, or MLA style). Not to do so is to commit plagiarism, a form of academic dishonesty. If you are not absolutely clear on what constitutes plagiarism and how to cite sources appropriately, now is the time to learn. Please ask me! Please be aware that the consequences for plagiarism or other forms of academic dishonesty will be severe. Students who violate university standards of academic integrity are subject to disciplinary action, including a reduced grade, failure in the course, and suspension or dismissal from the University.

Statement of Inclusion

Inclusive Illinois Committee Diversity Statement

As the state's premier public university, the University of Illinois at Urbana-Champaign's core mission is to serve the interests of the diverse people of the state of Illinois and beyond. The institution thus values inclusion and a pluralistic learning and research environment, one which we respect the varied perspectives and lived experiences of a diverse community and global workforce. We support diversity of worldviews, histories, and cultural knowledge across a range of social groups including race, ethnicity, gender identity, sexual orientation, abilities, economic class, religion, and their intersections.

Accessibility Statement

To obtain accessibility-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call (217) 333-4603 (V/TTY), or e-mail a message to disability@illinois.edu.

Emergency response: Run, Hide, Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with any kind of emergency – like fire, severe weather or if someone is trying to hurt you – The University of Illinois Police Department recommends three options: Run, hide or fight.

Assignments and Evaluation

All assignments are required for all students. All work must be completed in order to pass this class. Late or incomplete assignments will not be given full credit unless the student has contacted the instructor prior to the due date of the assignment (or in the case of emergencies, as soon as practicable).

Assignments, Exercises & Grade Distribution:

- Eleven graded assignments (due 1 hour before class meeting in the week they are due): 5 points each (55 points total).
- Eleven ungraded exercises (due 25 hours before class meeting in the week they are due): 2 points each for completion (22 points total).
- Four reading responses: 5 points each (20 points total).
- Attendance and participation in class and on forums: 3 points.

Grading Scale:

94-100 = A
90-93 = A-
87-89 = B+
83-86 = B
80-82 = B-
77-79 = C+
73-76 = C
70-72 = C-
67-69 = D+
63-66 = D
60-62 = D-
59 and below = F

Reading Responses

Up to twenty points are available for four critical questions posted to the class discussion forum and identified in the subject line as a *reading response* together with a topic description. Critical questions are carefully worded descriptions of an obstacle to understanding and applying concepts and methods covered in the assigned readings. These need to be more than a simple request for clarifying a term or idea. Each question should be one to three paragraphs in length, and should include:

- A one sentence summary of the question (citing the location of the anomalous passage in the reading);
- A longer, lucid explanation of the question and the obstacle that it identifies;
- A justification for why the question is important;
- Some remarks on the context in which the question arose: how did you recognize that it was a problem?

Topic Schedule

Week 2: January 23: Models and Domains

Week 3: January 30: Propositional Logic

Required Readings: Benthem et al. 2014a

Due: Ungraded Exercise 1, Propositional logic exercise

Due: Graded Assignment 1, SVG diagram assignment

Week 4: February 06: Predicate Logic

Required Readings: Benthem et al. 2014b

Due: Ungraded Exercise 2, Predicate logic exercise 1

Due: Graded Assignment 2, Propositional logic assignment

Week 5: February 13: Predicate Logic

Required Readings: Benthem et al. 2014b

Due: Graded Assignment 3, Predicate logic assignment

Due: Ungraded Exercise 3, Predicate logic exercise 2

Week 6: February 20: Sets, relations, and functions

Required Readings: Partee 2006

Due: Ungraded Exercise 4, Set theory exercise

Week 7: February 27: UML and relational modeling

Required Readings: Seidl et al. 2015; Teorey et al. 1986

Due: Ungraded Exercise 5, UML class diagram exercise

Due: Graded Assignment 4, Set theory assignment

Week 8: March 06: Normal forms and normalization

Required Readings: Kent 1983

Due: Ungraded Exercise 6, Relational modeling exercise

Due: Graded Assignment 5, UML class diagram assignment

Week 9: March 13: Syntax and Grammar

Required Readings: Rosen 1988

Due: Graded Assignment 6, Relational modeling assignment

Due: Ungraded Exercise 7, Formal grammar exercise

Week 10: Spring Break: March 20:

Week 11: March 27: Semantics and Interpretation

Required Readings: Bach 1989

Due: Ungraded Exercise 8, Formal semantics exercise

Due: Graded Assignment 7, Formal grammar assignment

Week 12: April 03: The RDF model and language

Required Readings: Manola et al. 2014

Due: Graded Assignment 8, Formal semantics assignment

Due: Ungraded Exercise 9, RDF description exercise

Week 13: April 10: Description Logics

Required Readings: Krötzsch et al. 2012

Due: Graded Assignment 9, RDF description assignment

Due: Ungraded Exercise 10, Description logic exercise

Week 14: April 17: Ontologies

Required Readings: Hitzler et al. 2012; Manola et al. 2014

Due: Ungraded Exercise 11, OWL ontology exercise

Due: Graded Assignment 10, Description logic assignment

Week 15: April 24: Looking Ahead

Due: Graded Assignment 11, OWL ontology assignment

Week 16: May 1: Wrapup and Evaluation

Readings

Bach, E. 1989. "Background and Beginning, Worlds Enough and Time." In *Informal Lectures on Formal Semantics*. Albany, NY, 1–32. https://uofi.box.com/s/lfqsrzjkhzdzml9d2g5w0ndtyvn0ndom.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014a. "Chapter 2: Propositional Logic". In *Logic in Action*. Amsterdam, NL, 2.1–2.37. http://www.logicinaction.org/docs/ch2.pdf.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014b. "Chapter 4: The World According to Predicate Logic". In *Logic in Action*. Amsterdam, NL, 4.1–4.53. http://www.logicinaction.org/docs/ch4.pdf.

Hitzler, P, Krötzsch, M, Parsia, B, Patel-Schneider, P F, and Rudolph, S. 2012. "OWL 2 Web Ontology Language Primer". http://www.w3.org/TR/owl2-primer/.

Kent, W. 1983. "A Simple Guide to Five Normal Forms in Relational Database Theory". *Commun. ACM* 26.2, 120–125. http://doi.acm.org.proxy2.library.illinois.edu/10.1145/358024.358054.

Krötzsch, M, Simancík, F, and Horrocks, I. 2012. "A Description Logic Primer". *arXiv preprint arXiv:1201.4089*. http://arxiv.org/abs/1201.4089.

Manola, F, Miller, E, and McBride, B. 2014. "RDF 1.1 Primer"., Cambridge, MA. https://www.w3.org/TR/2014/NOTE-rdf11-primer-20140624/.

Partee, B H. 2006. "Basic Concepts of Set Theory, Functions and Relations". http://people.umass.edu/partee/NZ_2006/Set%20Theory%20Basics.pdf.

Rosen, K H. 1988. "Languages and Grammars". In *Discrete Mathematics and its Applications*. New York, 552–563. https://uofi.box.com/s/nomrry0e4cone88xvnciaf14gg93t68h.

Seidl, M, Scholz, M, Huemer, C, and Kappel, G. 2015. "The Class Diagram". In *UML @ Classroom: An Introduction to Object-Oriented Modeling*. Eds. M. Seidl, M. Scholz, C. Huemer, and G. Kappel. Cham, 49–84. http://dx.doi.org/10.1007/978-3-319-12742-2_4.

Teorey, T J, Yang, D, and Fry, J P. 1986. “A logical design methodology for relational databases using the extended entity-relationship model”. *ACM Comput. Surv.* 18.2, 197–222. http://doi.acm.org/10.1145/7474.7475.