Information Modeling

University of Illinois School of Information Sciences

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IS561-AO  
Spring 2018  
Monday 5:00-7:00 PM  
Meets 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

### Content 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.

### Teamwork and Communication Objectives

1. Develop and practice strong teamwork skills.
2. Develop and practice strong oral and written communication skills.

# Course Materials

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

Any changes made to the topic schedule, readings, or assignments will be posted to the Moodle calendar for the class.

# About Michael Gryk

Dr. Michael R. Gryk is currently Associate Professor of Molecular Biology and Biophysics at UCONN Health, the medical school at the University of Connecticut. He is also a doctoral student of Library and Information Science at the School of Information Sciences, University of Illinois at Urbana – Champaign. Dr. Gryk has worked in the field of structural biology, concentrating on bioNMR, since 1990. His recent research interests are in the computational and informational science aspects of biomedical research. He received his M.S. in chemistry from the University of Connecticut and his Ph.D. in biophysics from Stanford University, Stanford, California.

# Teaching Assistants

## About Jacob Jett

Jacob employs formal methods to examine issues in the conceptual foundations of information access, organization, and retrieval, especially with regards to web and data semantics. Knowledge representation techniques and modeling exercises, such as ontology development and conceptual modeling, represent a sizable area of overlap in his research.

## About Kangjae Lee

Kangjae Lee is a Ph.D. student in Informatics. He has experience in research on ontology models and location-based service (LBS) in 3D indoor spaces. His current research interest is on the impact of environmental factors and their associations with physical activity in the context of spatial and temporal dimensions.

## About Lo Lee

Lo Lee is a first year PhD student at the School of Information Sciences. Her current research interest is on the design of interactive media. She is particularly interested in examining citizen science platforms that are used to launch public collaborative scientific projects.

# Library Resources

<http://www.library.illinois.edu/infosci/>  
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](http://www.inclusiveillinois.illinois.edu/supporting_docs/Inclusive%20Illinois%20Diversity%20Statement.pdf)

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](http://disability.illinois.edu/) (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.

# Basic Needs Issues

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Assistant Dean for Student Affairs for support. Furthermore, please notify the professor if you are comfortable in doing so.

## 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](http://police.illinois.edu/safe) recommends three options: run, hide or fight. <http://police.illinois.edu/dpsapp/wp-content/uploads/2017/08/syllabus-attachment.pdf>.

# 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). Comprehension quizzes may be repeated up until the deadline.

## Assignments, Exercises & Grade Distribution

|  |  |
| --- | --- |
| Assignment Type | Percentage of Grade |
| Three group projects | 45% |
| Written reading responses and homework | 25% |
| Comprehension quizzes (usually due on Friday) | 15% |
| Exercises and participation in class | 15% |

### 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

### Comprehension quizzes

Comprehension quizzes are based on the reading assignments, and are completed online. Their purpose is to help ensure that you understand the concepts and methods presented by the authors of our readings. A link to each quiz will be posted to the Moodle calendar.

### Reading responses and homework assignments

You will be assigned written exercises that are based on the required readings. Like the comprehension quizzes, these assignments will help you assess your understanding of the material you've read. Some of these assignments will be reading responses: questions posed by the instructors that require you to reflect more thoughtfully on what you've read than exercises with right and wrong answers. Typical reading responses are two to four paragraphs in length, and are graded based on how thoughtfully and lucidly you have engaged with the question.

### Group classroom exercises

Classroom exercises involve practice with the course content and its application in information modeling scenarios. Engagement with the problem at hand, cooperation with group members, and thoughtful spoken and written treatment of issues that arise are the most important factors in assessing your contributions in this setting, just as they are in the working world.

### Group Modeling Projects

You will be assigned to three groups and contribute to three analysis and modeling projects over the course of the semester. Some of your work on these case studies will take place during class, but you will need to meet as a group outside of class to complete each step of each project. Your instructors will provide detailed instructions for each of the projects, but all three will require you to prepare an account of the project domain in written natural language, abstractions in one or more artificial languages, and one or more diagrams. Deliverables for these projects will be staged, with three graded assignments per project.

### Participation

Your participation grade is a combination of your attendance, in-class participation, and overall progress throughout the semester; all assessed by your instructor.

The following rubric will be used to assign a score:

10

Student has been an active participant in class discussion, bringing to the class insights from their interpretations of readings and lived experiences and is demonstrating an increasing grasp of the key concepts covered in class.

8

Student has been an active participant in some of the class discussion and is demonstrating some gains in grasping key concepts covered in class.

6

Student is occasionally active in class and is demonstrating some learning, but it is clear they are not performing to their full capabilities.

4

Student has missed several classes and/or is not always active when attending class.

0

Student has consistently missed class during the rated period.

# Topic Schedule

### Week 0: Week before classes

### Week 1: January 15 is a holiday: no class meeting

#### Topic: Models and Modeling

* **Required Readings:** Seidl et al. 2015a

### Week 2: January 22

* **Due January 26:** Closing date, Quiz 1

#### Topic: Logic and Foundations

* **Required Readings:** Rosen 2011c

### Week 3: January 29

* **Due February 2:** Closing date, Quiz 2
* **Due January 28:** Upload deadline, Homework Assignment 1

#### Topic: Class Diagrams

* **Required Readings:** Seidl et al. 2015b

#### Topic: Sets and relations

* **Required Readings:** Rosen 2011a

#### Topic: Logic, classes, and relationships

* **Required Readings:** Bach 1989a

### Week 4: February 5

* **Due February 4:** Upload deadline, Homework Assignment 2
* **Due February 9:** Closing date, Quiz 3

#### Topic: Relational Algebra

* **Required Readings:** Wenholz 2012

#### Topic: Relations

* **Required Readings:** Rosen 2011f

### Week 5: February 12

* **Due February 11:** Upload deadline, Homework Assignment 3
* **Due February 15:** First deliverables, First Group Project
* **Due February 16:** Closing date, Quiz 4

#### Topic: Semantics and Interpretation

* **Required Readings:** Bach 1989a, 1989b

### Week 6: February 19

* **Due February 23:** Closing date, Quiz 5
* **Due February 18:** Upload deadline, Homework Assignment 4

#### Topic: Models, Domains, Properties, and Relationships

* **Required Readings:** Jubien 1997

### Week 7: February 26

* **Due March 2:** Closing date, Quiz 6
* **Due February 25:** Upload deadline, Homework Assignment 5
* **Due March 1:** Second deliverables, First Group Project

#### Topic: Predicate Logic, Part 1

* **Required Readings:** Benthem et al. 2014b, 2014c, 2014d, 2014a

### Week 8: March 5

* **Due March 4:** Upload deadline, Homework Assignment 6
* **Due March 9:** Closing date, Quiz 7

#### Topic: Predicate Logic, Part 2

### Week 9: March 12

* **Due March 15:** First deliverables, Second Group Project
* **Due March 16:** Closing date, Quiz 8
* **Due March 11:** Upload deadline, Homework Assignment 7
* **Due March 15:** Third deliverables, First Group Project

#### Topic: Syntax and Grammar

* **Required Readings:** Rosen 2011e

### Spring Holiday: March 19

### Week 11: March 26

* **Due March 30:** Closing date, Quiz 9
* **Due March 25:** Upload deadline, Homework Assignment 8

#### Topic: Graphs

* **Required Readings:** Rosen 2011d

#### Topic: Automata

* **Required Readings:** Rosen 2011b

### Week 12: April 2

* **Due April 5:** Second deliverables, Second Group Project
* **Due April 1:** Upload deadline, Homework Assignment 9
* **Due April 6:** Closing date, Quiz 10

#### Topic: Conceptual Graphs

* **Required Readings:** Pan et al. 2017

### Week 13: April 9

* **Due April 12:** Third deliverables, Second Group Project
* **Due April 8:** Upload deadline, Homework Assignment 10
* **Due April 13:** Closing date, Quiz 11

#### Topic: The RDF model and language

* **Required Readings:** Beckett et al. 2014; Manola et al. 2014

### Week 14: April 16

* **Due April 19:** First deliverables, Third Group Project
* **Due April 20:** Closing date, Quiz 12
* **Due April 15:** Upload deadline, Homework Assignment 11

#### Topic: Description Logics

* **Required Readings:** Krötzsch et al. 2014; Porter et al. 2008

### Week 15: April 23

* **Due April 27:** Closing date, Quiz 13
* **Due April 22:** Upload deadline, Homework Assignment 12

#### Topic: Ontologies

* **Required Readings:** Hitzler et al. 2012; Krötzsch et al. 2012

### Week 16: April 30

* **Due May 4:** Closing date, Quiz 14
* **Due April 29:** Upload deadline, Homework Assignment 13
* **Due May 3:** Second deliverables, Third Group Project

#### Topic: Wrapup and Evaluation

### Week 17: Finals Week

* **Due May 6:** Upload deadline, Homework Assignment 14
* **Due May 10:** Third deliverables, Third Group Project

# Readings

Bach, E. 1989a. “Background and Beginning”. In *Informal Lectures on Formal Semantics*. Albany, NY, 1–17. <https://uofi.box.com/s/lfqsrzjkhzdzml9d2g5w0ndtyvn0ndom>.

Bach, E. 1989b. “Worlds Enough and Time.” In *Informal Lectures on Formal Semantics*. Albany, NY, 19–32. <https://uofi.box.com/s/lfqsrzjkhzdzml9d2g5w0ndtyvn0ndom>.

Beckett, D, Berners-Lee, T, Prud’hommeaux, E, and Carothers, G. 2014. “RDF 1.1 Turtle”. <https://www.w3.org/TR/turtle/>.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014a. “Formulas, situations, and pictures”. In *Logic in Action*. Amsterdam, NL, 4.17–4.25. <http://www.logicinaction.org/docs/ch4.pdf>.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014b. “Learning the language by doing”. In *Logic in Action*. Amsterdam, NL, 4.2–4.8. <http://www.logicinaction.org/docs/ch4.pdf>.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014c. “Practising translations”. In *Logic in Action*. Amsterdam, NL, 4.8–4.13. <http://www.logicinaction.org/docs/ch4.pdf>.

Benthem, J van, Ditmarsch, H van, Eijck, J van, and Jaspars, J. 2014d. “Reasoning patterns with quantifiers”. In *Logic in Action*. Amsterdam, NL, 4.13–4.16. <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/>.

Jubien, M. 1997. “Platonism”. In *Contemporary Metaphysics: An Introduction*. Cambridge MA, 36–62. <https://courseweb.lis.illinois.edu/lis/2014fa/lis590ro/readings/Jubien97ch2-3.pdf>.

Krötzsch, M, Simancik, F, and Horrocks, I. 2012. “The description Logic SROIQ”. <https://courses.ischool.illinois.edu/pluginfile.php/351280/mod_resource/content/1/SROIQ.pdf>.

Krötzsch, M, Simancík, F, and Horrocks, I. 2014. “Description Logics”. *IEEE Intelligent Systems* 29.1, 12–19. <http://ieeexplore.ieee.org/document/6671572/>.

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

Pan, J Z, Vetere, G, Gomez-Perez, J M, and Wu, H (eds.). 2017. “Knowledge graphs: Foundations”. In *Exploiting Linked Data and Knowledge Graphs in Large Organisations*. Cham, 17–38. <http://link.springer.com/10.1007/978-3-319-45654-6>.

Porter, B, Lifschitz, V, and Van Harmelen, F (eds.). 2008. “DLs in Ontology Language Applications”. In *Handbook of knowledge representation*1st ed. Foundations of artificial intelligence. Amsterdam ; Boston, 166–168.

Rosen, K H. 2011a. “Basic structures: Sets and functions”. In *Discrete Mathematics & Applications*. New York, 113–155.

Rosen, K H. 2011b. “Finite Automata”. In *Discrete Mathematics & Applications*. New York, 858–877.

Rosen, K H. 2011c. “Foundations: Logic”. In *Discrete Mathematics & Applications*. New York, 1–68.

Rosen, K H. 2011d. “Graphs and graph models”. In *Discrete Mathematics & Applications*. New York, 641–649.

Rosen, K H. 2011e. “Languages and Grammars”. In *Discrete Mathematics and its Applications*. New York, 847–857.

Rosen, K H. 2011f. “Relations: Properties and Applications”. In *Discrete Mathematics & Applications*. New York, 573–590.

Seidl, M, Scholz, M, Huemer, C, and Kappel, G. 2015a. “Introduction”. In *UML @ Classroom: An Introduction to Object-Oriented Modeling*. Eds. M. Seidl, M. Scholz, C. Huemer, and G. Kappel. Cham, Germany, 1–5. <http://dx.doi.org/10.1007/978-3-319-12742-2_1>.

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

Wenholz, K. 2012. “Relational Algebra: A Brief Introduction”. <http://buzzard.ups.edu/courses/2012spring/projects/wenholz-relational-algebra-ups-434-2012.pdf>.