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

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.

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

# About Michaek 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 you 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.

### 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

Analysis and modeling projects completed in groups

### Reading responses and homework assignments

Reading responses and homework assignments

# Topic Schedule

### Week 0: Week before classes

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

* Models and Modeling
  + **Required Readings:** Seidl et al. 2015a

### Week 2: January 22

* Logic and Foundations
  + **Required Readings:** Rosen 2011c

### Week 3: January 29

* Logic, classes, and relationships
  + **Required Readings:** Bach 1989a
* Class Diagrams
  + **Required Readings:** Seidl et al. 2015b
* Sets and relations
  + **Required Readings:** Rosen 2011a

### Week 4: February 5

* Relational Algebra
  + **Required Readings:** Wenholz 2012
* Relations
  + **Required Readings:** Rosen 2011f

### Week 5: February 12

* Semantics and Interpretation
  + **Required Readings:** Bach 1989a, 1989b

### Week 6: February 19

* Models, Domains, Properties, and Relationships
  + **Required Readings:** Jubien 1997

### Week 7: February 26

* Predicate Logic, Part 1
  + **Required Readings:** Benthem et al. 2014b, 2014c, 2014d, 2014a

### Week 8: March 5

* Predicate Logic, Part 2

### Week 9: March 12

* Syntax and Grammar
  + **Required Readings:** Rosen 2011e

### Spring Holiday: March 19

### Week 11: March 26

* Graphs
  + **Required Readings:** Rosen 2011d
* Automata
  + **Required Readings:** Rosen 2011b

### Week 12: April 2

* Conceptual Graphs
  + **Required Readings:** Pan et al. 2017

### Week 13: April 9

* The RDF model and language
  + **Required Readings:** Beckett et al. 2014; Manola et al. 2014

### Week 14: April 16

* Description Logics
  + **Required Readings:** Krötzsch et al. 2014

### Week 15: April 23

* Ontologies
  + **Required Readings:** Hitzler et al. 2012; Porter et al. 2008

### Week 16: April 30

* Wrapup and Evaluation

# 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, 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>.