USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences
Spatial Sciences Institute

SSCI 582 (35695), Spatial Databases

Syllabus

Units: 4

Term – Day – Time: Spring 2019, Online

Location: Online

Instructor: An-Min Wu, PhD
Office: AHF B55B
Regular Office Hours: Tuesdays, 3 - 4 p.m. and Thursdays, 12 – 1 p.m. PT via Blue Jeans – please contact me via email in advance to ensure I will be online. Also available most days and times by appointment via email
Contact Info: anminwu@usc.edu, 213-740-2876 (office), http://bluejeans.com/anminwu

Library Help: Andy Rutkowski
Office: VKC B36B
Regular Office Hours: By appointment
Contact Info: arutkows@usc.edu, 213-740-6390 (office), http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF B57E
Regular Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)

Course Scope and Purpose

Geographic information systems (GIS) are fundamentally information systems, typically built on database management technologies. Although GIS offers special facilities for storing and manipulating spatial data, much of the functionality provided by GIS is shared with conventional database software and its ubiquitous Structured Query Language (SQL). Thus, understanding database principles is the foundation for mastering the technical aspects of GIS.

This course provides a high-level tour of the theoretical underpinnings of databases containing both spatial and tabular data, as these are integrated into GIS. However, the core objective of the course is a practical one: to understand the fundamental principles of the design and implementation of well-conceived spatial databases, especially Esri geodatabases, and be able to manipulate them both inside and outside of GIS.

In addition, this course serves a diverse audience given its role as a required course for the Geographic Information Science & Technology M.S. and Graduate Certificate Programs, and as an elective course in the Spatial Data Science M.S. Program. The different student audiences are provided a variety of options in working with core geospatial datasets throughout the semester that best coincide with their personal academic and career goals.

In this course we examine the fundamentals of relational, object-oriented, and unstructured databases. A major benefit of the relational model is that it provides a metaphor that is closer to the way humans think about data than did previous database models. Yet within GIS, some authors have argued that the object-oriented model provides an inherently more suitable basis for storing geographical data than the relational model. The unstructured model is increasingly being used to support applications including big data storage and retrieval (e.g. Twitter, Facebook, Google). The influence of object-oriented concepts has become steadily more dominant throughout virtually every aspect of modern computing. Anyone wishing to pursue a career in GIS, in fact in any aspect of computing, should gain an understanding of both the relational and object-oriented models with respect to spatial databases.

Learning Outcomes

When you have completed this course, you will be able to:

- Discuss the complexity of the geographic world and techniques for modeling it in a computer.
- Explain the strengths and limitations of various databases and non-relational structures for spatial data, including those supported by Esri's ArcGIS platform and open source systems.
- Use SQL fragments and/or statements as appropriate to interrogate spatial databases to accomplish data loading, maintenance, map production, and analysis.
- Define a geographical realm of interest, model that realm diagrammatically and narratively, and implement the model in a geodatabase.

Prerequisite(s): SSCI 581 or permission of the instructor
Co-Requisite(s): None

Course Structure

The main theoretical concepts are provided through a directed reading of the text *Spatial Database Systems: Design, Implementation and Project Management.* The course readings will emerge as a collection of reading notes that provide the basis for an informed review of most chapters. Additional readings are assigned to expand on the text when needed.

This course will unfold on a weekly basis. When possible, assignments will be given in advance, but usually they will be posted on or before Mondays. Practical exercises utilize unpublished and published tutorial materials using the ArcGIS platform, and a final project allows students to demonstrate their ability to apply spatial analytical tools in an appropriate, informed manner.

Workload – This is a four credit, one semester course. Students should expect to spend 10-15 hours per week completing the work in this course.

Technological and Communication Requirements

ArcGIS is provided online via the SSI Server; hence, you do not need to install it on your own computer. Instead, every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone for use whenever a presentation or meeting is scheduled.
- An up-to-date web browser to access the SSI Server.

SSI Server and Tech Support – This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software. If you are unable to connect to the server or experience any type of technical issues, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu making sure to copy (cc) me on the email.

Communications – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard. It is each student's responsibility to stay informed about what is going on in our course. In addition to email about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. Be sure to check these each time you log onto Blackboard.

I will send via email through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all email sent from Blackboard or from me. Do not ignore course email until the day before assignments are due. Also double check to be sure that email sent from the USC blackboard account does not go into your junk mail!

While I am usually on-line all day and will probably respond to emails from students very quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72-hours delay. In the rare case when I expect to be off-line for more than 72 hours, I will post an announcement on the Blackboard site.

Discussion forums – On the Blackboard site, I will post a series of discussion threads relevant to various sections of the course. Discussions provide a key means for student-to-student discussion and collaboration that can replicate the face-to-face contact you may have experienced in traditional classrooms. Here students can provide support to each other while working on your assignments, sharing hints and helpful tips, as you would in a classroom laboratory. Please post your questions about assignments there, as you would ask them publically in the classroom. I monitor the discussion threads and offer comments when necessary, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Required Readings and Supplementary Materials

The required textbook for this course is:

- Yeung, Albert K. W., and G. Brent Hall. 2007. *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer. While you may purchase this book if you wish to own a bound copy, it is available online through the USC Libraries. Sign on to the USC Libraries and search for this title. Used copies of this book are widely available online, so there is no need to pay the full retail price.

Supplementary readings will be assigned from various sources including:

- Couclelis, Helen. 1992. “People Manipulate Objects (But Cultivate Fields): Beyond the Raster-Vector Debate in GIS.” In *Therories and Methods of Spatio-Temporal Reasoning in Geographic Space*. Edited by Andrew U. Frank, Irene Campari, and Ubaldo Formentini, 65-77. London: Springer.
- Hunter, Gary J. 2002. "Understanding Semantics and Ontologies: They're Quite Simple, Really - If You Know What I Mean." *Transactions in GIS* 6, no. 2 (March): 83-87.
- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2005. “Chapter 3: Representing Geography.” In *Geographical Information Systems and Science*, 63-83. 2nd ed. Hoboken, NJ: Wiley.
- Peuquet, Donna J. 1999. "Chapter 8: Time in GIS and geographical databases." In *Geographical Information Systems: Principles, Techniques, Management, and Applications*. Edited by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, 91-103. 2nd ed. Hoboken, NJ: Wiley.
- Shekhar, Shashi, and Sanjay Chawla. 2003. “Chapter 2: Spatial Concepts and Data Models”, “Chapter 3: Spatial Query Languages”, and “Chapter 4: Spatial Storage and Indexing”. In *Spatial Databases: A Tour*, 22-51, 52-82, and 83-113. 1st ed. Upper Saddle River, NJ: Prentice Hall.

- Wilson, John P., and John C. Gallant. 2000. "Digital Terrain Analysis." In *Terrain Analysis: Principles and Applications*. Edited by John P. Wilson and John C. Gallant, 1-26. Hoboken, NJ: Wiley.
- Zeiler, Michael. 2010. “Chapter 1: Inside the Geodatabase.” In *Modeling Our World: The Esri Guide to Geodatabase Concepts*, 1-22. 2nd ed. Redlands, CA: Esri Press.

As well, for several of the assignments in this course, you will conduct online library research to find articles that apply specific techniques in an application area of your choice.

Description and Assessment of Assignments

Weekly Assignments

Your grade in this course will be determined on the basis of several different assessments.

Resume Assignment – 1 worth a total of 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Please prepare your resume in the SSI template which will be provided to you. Unless you opt out, your resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is compiled annually and, along with our web presence, is used to promote our programs, and more importantly, your skills, experience and professional aspirations.

Tutorials – 5 worth a total of 35 points. Due in the weeks between reading assignments, hands-on tutorials will be used to practice the techniques explored in theory in the text. At the completion of each tutorial, you will prepare a brief written report to demonstrate that you have completed it.

Reading Assignments – 5 worth a total of 20 points. These will focus on the text and other assigned readings. Their objective is to help you evaluate and integrate the information you have acquired from the course readings. Some of these will involve discussions and collaborative work, most will be individual efforts. Others will stimulate in-depth investigation into the ontology and semantics of core geospatial datasets integrated into tutorials.

Discussions – 5 worth a total of 10 points. Structured discussions will focus on combinations of theory and practice. You will post new message and replies to messages posted by your classmates (i.e. two per forum) at specified times throughout the semester.

Wiki Assignments – 5 worth a total of 10 points. Students will utilize new knowledge gained from discussions, readings and hands-on assignments to build toward the final project through a series of peer-reviewed implementations of lessons posted within Blackboard Wikis.

Final Project

To integrate your learning of all the material covered in the course, in the final project, you will design, undertake, and report on an individually-chosen spatial database project that will be the context of discussion in many of the assignments throughout the semester that will be used to

build toward the final project. The project components will be due at different times throughout the semester to build gradually on the material presented in the course. All points for project components will be assigned using a grading rubric provided at the time the project assignment is posted. The four components of the Project are:

Proposal - 3 points. A brief description of the spatial question(s) you would like to ask or the spatial problem you want to solve and briefly how you plan to solve it.

Geodatabase Design & Implementation Video – 5 points. A video illustrating your overall spatial database design and functionality.

Presentation - 5 points. A presentation made on-line via Blue Jeans, open to all students in the course.

Final Project Report - 10 points. A written report on methods, data sources, and resulting database structure.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Weekly Assignments			
Resume Assignment	1	2	2
Tutorials	5	7	35
Reading Assignments	5	4	20
Discussions	5	2	10
Wiki Assignments	5	2	10
Project Components			
Proposal	1	3	3
Geodatabase Video	1	5	5
Presentation	1	5	5
Final Report	1	10	10
Total	25	-	100

Assignment Submission Policy

Unless otherwise noted, assignments must be submitted via Blackboard by the due dates specified in the Course Schedule below and on the assignment instructions. Unless otherwise noted, all Reading Assignments and Tutorials are *due by 11:59 pm Pacific Time (PT) on the due date*. Project components have different due dates as indicated on the Course Schedule below. Your attention to on-time assignment submission is essential.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points up to FOUR days late. No points will be given for submissions more than FOUR days late. Note that all assignments worth 2 points will receive 0 points if submitted late.
- Additionally, no written work will be accepted for grading after 5 pm PT on the last day of classes.

Schedule

	Topic	Readings and Assignments	Deliverables/Due Dates
Week 1 1/7	Getting Started	Longley et al. (2005) Ch.3, pp. 63-83 Resume Assignment Reading Assignment 1	Resume Assignment: Thursday, 1/10
Week 2 1/14	Technological Context	Yeung & Hall (2007) Ch.1 Zeiler (2010) Ch.1 Tutorial 1 Discussion 1	Reading Assignment 1: Tuesday, 1/15 Discussion 1: Thursday, 1/17
Week 3 1/22* *Monday, 1/21 is university holiday	Fields as Objects	Yeung & Hall (2007) Ch.2, to p. 35, and Ch3. to p. 78 Discussion 2	Tutorial 1: Thursday, 1/24
Week 4 1/28	Semantics and Ontology	Hunter (2002) Tutorial 2 Reading Assignment 2	Discussion 2: Tuesday, 1/29
Week 5 2/4	Representing Terrain	Yeung & Hall (2007) Ch.2, from p.35 Wilson & Gallant (2000)	Reading Assignment 2: Tuesday, 2/5 Tutorial 2: Thursday, 2/7
Week 6 2/11	Data Modeling	Yeung & Hall (2007) Ch.3, to p. 79 Shekhar & Chawla (2003) Ch 2 Discussion 3 Reading Assignment 3	Final Project Proposal Meeting: Wednesday, 2/13 - Friday, 2/15 Discussion 3: Thursday, 2/14
Week 7 2/19* *Monday, 2/18 is university holiday	Esri Geodatabases (I) Final Project kick-off	Tutorial 3 Discussion 4	Reading Assignment 3: Tuesday, 2/19
Week 8 2/25	Database Mechanics Final Project Week 1	Yeung & Hall (2007) Ch.3, from p. 79 Reading Assignment 4: Normalization & Generalization Reading Assignment 4	Discussion 4: Tuesday, 2/26 Tutorial 3: Thursday, 2/28
Week 9 3/4	Esri Geodatabases (II) Final Project Week 2	Wiki Assignment 1 Tutorial 4	Reading Assignment 4: Tuesday, 3/5
3/11* *3/10-3/19 is Spring Recess	*Spring Recess*		
Week 10 3/18	Representing Time Final Project Week 3	Peuquet (1999) Wiki Assignment 2	Wiki Assignment 1: Tuesday, 3/19 Final Project Proposal: Wednesday, 3/20 Tutorial 4: Thursday, 3/21 and Friday, 3/22

	Topic	Readings and Assignments	Deliverables/Due Dates
Week 11 3/25	Legacy Geodata Final Project Week 4	Yeung & Hall (2007) Ch.4 Shekhar & Chawla (2003) Ch 3 & 4 Wiki Assignment 3 Reading Assignment 5 Tutorial 5	Wiki Assignment 2: Tuesday, 3/26 Check-in meeting
Week 12 4/1	Documentation Final Project Week 5	Yeung & Hall (2007) Ch.5 & 6 Wiki Assignment 4	Wiki Assignment 3 and Reading Assignment 5: Tuesday, 4/2
Week 13 4/8	Final Project Week 6	Wiki Assignment 5 Final Project Geodatabase	Wiki Assignment 4: Tuesday, 4/9 Tutorial 5: Thursday, 4/11
Week 14 4/15	Final Project Week 7	Discussion 5 Work on Final Project	Wiki Assignment 5: Monday, 4/15
Week 15 4/22* Friday, 4/26 is the last day of classes	Final Project	Final Project Completion	Geodatabase Design Implementation & Video: Wednesday, 4/24 Final Report & Final Discussion 5: 5 pm PT on Friday, 4/26
Final Exam Week 5/1-5/8	Final Presentations	Presentations	Final Project Presentation: Thursday, 5/2- Friday, 5/3

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255 – 24/7 on call
www.suicidepreventionlifeline.org

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support – (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs – (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

Student Support and Advocacy – (213) 821-4710
studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link https://libraries.usc.edu/. Also, the USC Libraries have many important resources available for distance students through the link: https://libraries.usc.edu/faculty-students/distance-learners. These include instructional videos, remote access to university resources, and other key contact information for distance students.