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

# SSCI 582 (35696), Spatial Databases

**Units:** 4
**Term:** Spring 2016
**Location:** Online, via Blackboard

**Instructor:** Jennifer N. Swift, PhD
**Office**: AHF B57D
**Office Hours**: Tuesdays and Thursdays 2-4 p.m. PT; also available most other days by appointment via email
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**GIS Librarian Help:** Katharin Peter
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**IT Help**: Richard Tsung
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**Course Description**

Geographic information systems (GIS) are fundamentally information systems, typically built on database management technologies. Although GIS offer specialist 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 in GIS. However, the core objective of the course is a practical one: to understand the fundamental principles in the design and implementation of well-conceived spatial databases, especially Esri geodatabases, and be able to manipulate them both inside and outside of GIS.

The Final Project involves building a geodatabase for a practical GIS application. This project has two main components: (1) a formal report (~2,000 words, excluding figures, tables, references, and map) that documents your project professionally – this must include a graphical geodatabase design, tabular data dictionary, sample data and queries; and (2) a succinct (~15-minutes) oral presentation of the project, as at a professional conference.

**Learning Objectives**

On completion of this course, students should 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 database and non-database structures for spatial data, particularly those supported by Esri's ArcGIS platform.
- 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, implement the model in a geodatabase.

**Prerequisite(s):** None
**Co-Requisite (s):** None
**Concurrent Enrollment:** None
**Recommended Preparation**: SSCI 581

**Course Structure**

This online course can be pursued entirely asynchronously; however, it also offers synchronous Web-based seminars, which are optional but strongly recommended, to discuss the assigned readings and various topics that arise from them. Each week will be focused on a particular aspect of spatial databases, delivered through course notes, readings, discussions, self-check activities and hands-on computer assignments. Students are encouraged to bring questions and problems to these seminars, to be explored in that congenial setting. The aim is to encourage deep-learning by active participation.

**Technological Proficiency and Hardware/Software Required**

We have several technologies that will facilitate our course work and our interactions, despite our dispersed locations. These include:

Blackboard – All course materials and correspondence will be posted on the course Blackboard site. As a registered student, you will find this course will show up in your available classes no later than 12:00 noon, PT on the first day of classes. It is here that the day-to-day flow of the course will be recorded.

Discussion boards – On the Blackboard site, we will post a number of discussion threads related to various course topics. These threads are very important in terms of providing support to each other while working on class exercises to share hints and helpful tips, as you would do in a classroom or lab setting. Your instructor will check the discussion threads periodically and offer occasional comments. Please send your instructor an email directly if you have a question or concern that requires immediate attention.

Live meetings and presentations – We will use browser-based platform called BlueJeans® to create synchronous, interactive sessions. With voice and webcam capabilities, this platform can be used to share presentations and even our desktops between two or more people.

Individual meetings – We will use BlueJeans® for one-on-one meetings.

GIST server and tech support – This course will utilize the SSI GIST Server to provide you with your own virtual desktop. You can access the GIST Server using VMware. If you are unable to connect to the server or experience any type of technical issues, send an email using your USC account to GIST Tech Support at gistsupport@dornsife.usc.edu, making sure to copy (cc) me on the email. GIST Tech Support is available Mondays through Fridays, from 10 a.m. to 5 p.m. PT.

Every student should be proficient with the MS Office suite (Excel, PowerPoint, and Word), all of which are available on the GIST Server. Documents in other software formats will not be accepted. In addition, students' personal computer systems must meet several technology requirements:

- An up-to-date computer with a fast Internet connection.
- A functional Web camera together with a microphone or headset for live sessions.
- A modern Web browser (Firefox, IE or Chrome is recommended) to run ArcGIS which is provided online via the GIST Server; you do not need to install ArcGIS on your own computer.

**Required Readings and Supplementary Materials**

There are two required texts for this course, available from the USC Bookstore or online outlets such as Amazon. Note also that the first text is available *free* through the USC Libraries as an e-Book.

- Yeung, Albert K. W. and G. Brent Hall. 2007. *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer, 553 pp.
- Zeiler, Michael. 2010. *Modeling Our World: The Esri Guide to Geodatabase Concepts*, 2nd ed. Redlands, CA: Esri Press, 308 pp.

There are several supplementary readings, also supplied by the instructor on Blackboard.

- 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.
- Guptill, Stephen C. 1999. "Metadata and data catalogs", in *Geographical Information Systems: Principles, Techniques, Management, and Applications*, 2nd ed., edited by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, 677-692. Hoboken, NJ: Wiley.
- Hunter, Gary J. 2002. "Understanding semantics and ontologies: They're quite simple, really - If you know what I mean." *Transactions in GIS* 6: 83-87.
- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2005. *Geographical Information Systems and Science,* 2nd ed., Ch.3, 63-83. Hoboken, NJ: Wiley.
- Peuquet, Donna J. 1999. "Time in GIS and geographical databases", in *Geographical Information Systems: Principles, Techniques, Management, and Applications*, 2nd ed., edited by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, 91-103. Hoboken, NJ: Wiley.
- 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.

In addition, one Esri tutorial and four Esri Web Campus (http://training.esri.com) courses, for a total of five, are supplied with this course.

- Getting Started with Geodatabase
- Getting Started with Geodatabase Topology
- Working with Geodatabase Domains and Subtypes
- Multidimensional Scientific Data Tools
- Transforming Data using Extract, Transform, and Load (ETL) Processes

**Description and Assessment of Assignments**

Performance in this course is determined on the basis of several assessment tools. Students update their student resume, prepare a set of research assignments and review

blogs on database theory, and complete a set of practical Esri Web training courses during the first 10 weeks of class; thus prepared, they undertake the Final Project during the final weeks of the semester.

Student Resume (2%): The GIST Programs require all current students to post and maintain a public resume, short biography and recent photo on our shared GIST 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.

Theory – Reading Assignments (16%): Students complete reading and writing assignments throughout the class. These assignments cover essential theoretical material and perspectives, intended to help integrate practical aspects of Esri geodatabases (below).

Discussion Forums (4%): These structured discussions and blogs 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 class.

Self-Check Assignments (15%): These structured online assignments focus on combinations of theory and practice. The questions will serve as a guide in your reading and as a basis for online discussions, blogs and spatial database tutorials. The goal is to have informed class activity, and to use your time to focus on applying, analyzing and evaluating the material with the aid of fellow students and with your instructor's guidance.

Practice - Tutorial Assignments (43%): Students work four hands-on tutorials with databases and ArcGIS on the GIST Server, and concurrently complete one online Esri Tutorial and four Esri Virtual Campus modules on geodatabases, during the first ten weeks of the class.

Final Project (20%): Students will work in small teams (2-5 max) on projects determined in consultation with the instructor, to develop and populate a practical geodatabase design with sample data. Team projects are emphasized to share the intellectual discovery process that inevitably accompanies geodatabase development, as well as to accomplish more substantial work in the time available, i.e. collecting the spatial and non-spatial data, importing those data into a suitably designed geodatabase, producing and interpreting maps, etc. During the last weeks of the class, students will be mostly doing work on Final Projects; the instructor may also participate. During this period, students maintain a Journal or Wiki on Blackboard discussing their progress and challenges during this period.

## Grading Breakdown

| Assignments | Number of Assignments | Points Per Assignment | % of Grade |
|---|---|---|---|
| | | | |
| Student Resume | 1 | 2 | 2 |
| Reading Assignments | 4 | 4 | 16 |
| Discussion Forums | 4 | 1 | 4 |
| Self-Check Assignments | 15 | 1 | 15 |
| Esri trainings | 5 | 3 | 15 |
| Tutorial Assignments | 4 | 7 | 28 |
| Final Project, components | | | |
| - Final Project Proposal | 1 | 2 | 2 |
| - GeoDB design | 1 | 5 | 5 |
| - GeoDB implementation video | 1 | 5 | 5 |
| - GeoDB report | 1 | 5 | 5 |
| - Oral presentation | 1 | 3 | 3 |
| **Totals** | **38** | **-** | **100** |

## Assignment Submission Policy

Unless otherwise notes, assignments will be submitted for grading via Blackboard using the due dates specified in the Course Schedule below. And finally, it is important to note from the outset that: (1) you are expected to attend and participate in pre-arranged online meetings and to complete and upload all assignments before the deadlines detailed in the Course Schedule; (2) late postings and assignments will be docked one grade and no grade will be given for postings or assignments turned in more than one week late; and (3) no written work will be accepted for grading after 5:00 p.m. PT on the last day of classes (see course schedule).

## Additional Policies

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 the Blackboard Assessment link. I will also create multiple Blackboard discussion forums throughout the semester that we will use for the aforementioned assignments and so we can discuss issues and comments on the course assignments, exercises and projects as the need arises.

In addition, I will send via e-mail through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all e-mail sent from Blackboard or from me. Check now to make sure that mail sent from both the USC blackboard accounts and my email jswift@usc.edu does not go into your junk mail!

While I am usually online and will probably respond to e-mails from students relatively quickly, I will endeavor to respond to all e-mail within 24 hours of receipt, aiming for no more than 48 hours delay. In the rare case when I expect to be offline for more than 72 hours, I will post an announcement on the Blackboard site. It is each student's responsibility to stay informed about what is going on in our course. In addition to e-mail

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.

Workload – This is a four credit, one semester course. Students should expect to spend 12-15 hours per week completing the work in this course.

**Course Schedule (Tentative)**

| | **Topics/Daily Activities** | **Readings and Assignments** | **Deliverables Due** |
|---|---|---|---|
| **Week 1**<br>1/11 | **Getting Started** | Longley et al. (2005) *Geographical Information Systems and Science*. Hoboken, NJ: Wiley - Ch.3, pp. 63-83<br><br>Student Resume (SR)<br>Self-Check Assignment 1<br>Reading Assignment 1: What is a Lake? | Mon 1/11, Introductions<br><br>Thurs 1/14, Student Resume, Self-Check Assignment 1 |
| **Week 2**<br>1/19<br>(Tues) | **Technological Context** | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.1<br>Zeiler (2010) *Modeling Our World: The Esri Guide to Geodatabase Concepts,* 2nd ed. Redlands, CA - Ch.1<br>Self-Check Assignment 2<br><br>Tutorial 1: SQL<br>Discussion 1 | Tues 1/19, Reading Assignment 1, Self-Check Assignment 2<br><br>Thurs 1/21, Discussion 1 |
| **Week 3**<br>1/25 | **Fields as Objects** | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.2, to p. 34, and Ch3. to p. 78<br>Couclelis (1992) "People manipulate objects (but cultivate fields): Beyond the raster-vector debate in GIS", in *Theories and Methods of Spatio-Temporal Reasoning in Geographic Space*, edited by Andrew U. Frank, Irene Campari, and Ubaldo Formentini, 65-77. London: Springer.<br><br>Self-Check Assignment 3 | Tues 1/26, Tutorial 1<br><br>Thurs 1/28, Self-Check Assignment 3 |

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| **Week 4**<br>2/1 | **Semantics and Ontology** | Hunter (2002) "Understanding semantics and ontologies: They're quite simple, really - If you know what I mean." *Transactions in GIS* 6: 83-87.<br>Self-Check Assignment 4<br>Tutorial 2<br>Discussion 2 | Tues 2/2, Self-Check Assignment 4<br>Thurs 2/4, Discussion 2 |
| **Week 5**<br>2/8 | **Representing Terrain** | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.2, from p.35<br>Wilson & 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.<br>Self-Check Assignment 5 | Tues 2/9, Tutorial 2<br>Thurs 2/11, Self-Check Assignment 5 |
| **Week 6**<br>2/16 | **Data Modeling** | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.3, to p. 79<br>Self-Check Assignment 6<br>Discussion 3<br>Reading Assignment 2: E-R Diagramming | Tues 2/16, Self-Check Assignment 6<br>Thurs 2/11, Discussion 3 |
| **Week 7**<br>2/22 | **Esri Geodatabases (I)**<br>**Final Project – kick-off** | Esri Certificate 1 (C1): Getting Started with the Geodatabase<br>Self-Check Assignment 7<br>Tutorial 3 | Tues 2/22, Self-Check Assignment 7, Reading Assignment 2<br>Thurs 2/25, Certificate 1 |
| **Week 8**<br>2/29 | **Database Mechanics**<br>**Final Project** – week 1 | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.3, from p. 79<br>Self-Check Assignment 8<br>Reading Assignment 3: Normalization<br>Discussion 4 | Tues 3/1, Self-Check Assignment 8, Tutorial 3<br>Thurs 3/3, Reading Assignment 3, Discussion 4 |
| **Week 9**<br>3/7 | **Esri Geodatabases (II)**<br>**Final Project** – week 2 | Self-Check Assignment 9<br>Esri Certificates 2 (C2): Topology & (C3): Domains<br>Tutorial 4 | Tues 3/8, Self-Check Assignment 9<br>Thurs 3/10, Certificates 2 & 3 |

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| 3/14-20 | **Spring Recess** | | |
| **Week 10**<br>3/21 | **Representing Time**<br>**Final Project** – week 3 | Peuquet (1999) "Time in GIS and geographical databases", in *Geographical Information Systems: Principles, Techniques, Management, and Applications*, 2nd ed., edited by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, 91-103. Hoboken, NJ: Wiley.<br>Self-Check Assignment 10<br>Esri Tutorial: Multidimensional Tools | Tues 3/20, Self-Check Assignment 10, Tutorial 4<br>Thurs 3/24, Final Project Proposal |
| **Week 11**<br>3/28 | **Legacy Geodata**<br>**Final Project** – week 4 | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.4<br>Self-Check Assignment 11<br>Esri Cert4 (C4): Transforming Data w/ETL<br>Reading Assignment 4 | Tues 3/29, Self-Check Assignment 11, Esri Tutorial<br>Thurs 3/31, Esri Cert4 |
| **Week 12**<br>4/4 | **Documentation**<br>**Final Project** – week 5 | Yeung & Hall (2007) *Spatial Database Systems: Design, Implementation and Project Management*. Dordrecht: Springer - Ch.5<br>Guptill, Stephen C. 1999. "Metadata and data catalogs", in *Geographical Information Systems: Principles, Techniques, Management, and Applications*, 2nd ed., edited by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, 677-692. Hoboken, NJ: Wiley.<br>Self-Check Assignment 12<br>Self-Check Assignment 13 | Tues 4/5, Reading Assignment 4, Self-Check Assignment 12<br>Thurs 4/7, Self-Check Assignment 13 |
| **Week 13**<br>4/11 | **Working on**<br>**Final Project** – week 6 | Self-Check Assignment 14<br>Final Project | Tues 4/12, Self-Check Assignment 14<br>Work on Final Project |
| **Week 14**<br>4/18 | **Finishing up**<br>**Final Project** | Self-Check Assignment 15<br>Final Project | Tues 4/19, Self-Check Assignment 15<br>Work on Final Project |

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| **Week 15**<br>4/25 | **Finishing up**<br>**Final Project** | All work must be submitted by 5:00 p.m. PT on Fri Apr 29, the last day of classes | Mon 4/25, Wed 4/27<br>Final Project Presentations<br>Thurs 4/28<br>Final Project Reports, Video |

**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 Section 11, *Behavior Violating University Standards* http://studentaffairs.usc.edu/scampus/. 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.

Discrimination, harassment, and sexual assault are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The *Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

***Support Systems***

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The *Office of Disability Services and Programs* https://dsp.usc.edu/ provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.