SSCI 582 – Spatial Databases (Section 35750)
Course Syllabus – Spring Semester 2014

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Office Hours: I am generally available mornings (Pacific Time) via Blackboard and email. I hold open recitation sessions on Wednesday and Thursday evenings. I am also available for private chats via Adobe Connect *by prior arrangement* via email, and *in case of emergency* on mobile. Just get in touch!

I encourage you to post your course-related questions on the Blackboard discussion boards so that we can share the knowledge among students in the most efficient way. I subscribe to the discussion forums on the Blackboard and receive notice immediately a post is made. **My priority is to read/respond to emails first, then posts.**

Course Scope and Purpose

Geographic information systems (GIS) are fundamentally information systems, typically built on database management technologies. Although GIS provide specialist facilities for storing and manipulating spatial data, much of the functionality offered 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, aka geodatabases, and be able to manipulate them both inside and outside of GIS. During the course, we will cover five major topics:

Geographical Complexity – We will first re-discuss the complexity of the geographical world, conceptually and experientially, and the modern GIS emphasis on semantics and ontology as approached to this complexity.

Spatial Data Structures – Concurrently, we will re-visit the evolution, benefits and constraints of spatial data structures used in GIS to date: simple graphic shapes, shapefiles, coverages, and databases (with spatial support).

Data Modeling Techniques – Through the first eight weeks, in interactive recitation sessions led by the instructor, supported by Web-hosted drawing tools, we will practice formal techniques for data modeling, as classically applied in database technologies.

Esri Geodatabases – Also in the first eight weeks, students will work individually on Esri Virtual Campus modules to develop skills in applying conceptual analysis, data modeling, and mapping of the geographical world, specifically using Esri geodatabases.

Metadata – In the last six weeks, again in interactive recitation sessions, in part led by student research presentations, we will deal with the imperative, notwithstanding difficulties, of proactively describing and managing spatial data, particularly in enterprise settings.

Learning Outcomes

On completion of this course, students should be able to:

- Understand the strengths and limitations of various database and non-database structures for spatial data
- Define a geographical realm of interest, model that realm diagrammatically and narratively, and implement the model in an Esri geodatabase
- Use SQL fragments and/or statements as appropriate, to interrogate (geo)databases

Course Formats

This is a graduate level course, so you should expect it to be both academically robust and intellectually challenging. As graduate students you are expected to actively engage with the material you are learning and to explore the heady cauldron of ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. Learning arises from active engagement with the knowledge found in our reading materials and with one another. As in any graduate class, the instructor's role is that of a guide who keeps you on this path of discovery and you will find that you will learn much from your fellow classmates. The challenge for us is to replicate such an academic experience within the milieu of "distance learning".

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through course notes and assigned readings. Reading assignments will give students an opportunity to internalize and apply the concepts and theory learned from readings. Some assignments require student interaction, all will benefit from it. Hands-on practical exercises will mainly use ArcGIS version 10.2, which is accessible via the Internet.

We have several technologies that will facilitate our interactions on course work, 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'll 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 (blogs) – 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 setting. I will check the discussion threads periodically and offer occasional comments. Please send me an email directly if you have a question or concern that requires my immediate attention.

Live meetings and presentations – We use a browser-based service called Adobe Connect™ to create synchronous, interactive sessions. With its integrated voice and video capabilities, Adobe Connect can be used to share presentations and interactive desktops among groups of up to 25 people. The *optional* recitation sessions in this course will be hosted on Adobe Connect, offering two alternative sessions each week for up to 8 participants. Final project presentations also will be hosted on Adobe Connect.

Individual meetings – While Adobe Connect can be used for one-on-one telemeetings, we also use free Internet-hosted voice and video technologies, such as Skype (http://www.skype.com/) and Google Hangouts for individual chats.

GIST server and tech support – This course will utilize the SSI GIST Server, which provides a virtual PC desktop. You can access the GIST Server at: https://gistonline.usc.edu. If you are unable to connect to the server or experience any type of technical issues, send an email to GIST Tech Support at: gistsupport@dornsife.usc.edu, copying the instructor. GIST Tech Support is only available Monday through Friday, 9:00am-5:00pm PT.

Assessments

Your grade in this class will be determined on the basis of several different assessment tools:

Resume Assignment – 1 for a total of 2 points. The GIST Program requires all current students to post and maintain a public resume, short biography, and recent photo on our shared Student Community Blackboard site (2 points). With your permission, your photo and resume will be posted to the Spatial Sciences Institute website and your resume will be included in the GIST Resume Book. The latter is compiled annually and along with our Web presence used to promote our programs and more importantly, your skills, experience, and professional aspirations.

Discussion Forums (Blogs) – 4 for a total of 16 points. Four discussion forums will appear during the course, treating a variety of theory and practice topics; in these, students' own experience, research, and/or opinion are sought. Students will be expected to make a minimum of four new posts, i.e. messages (one per forum) and eight replies (two or more per forum) to posts made by classmates.

Reading Assignments (Papers) – 5 for a total of 29 points. Students are required to complete five multi-part reading assignments and submit associated digests, termed "papers", for this class. The reading assignments will cover primarily the theory portion of the course as presented episodically through the course. In various ways, you will be encouraged to share your papers interactively with other students, primarily in Recitations. The objective of these papers is to help you integrate and re-evaluate the content of the readings, sharing with your classmates.

Topic Sessions – 8 for a total of 0 points. During the first half of the class, instructors *may* offer either asynchronous (Blackboard) or interactive (AdobeConnect) sessions on the week's theme topics. These sessions can be helpful to students who seek a more interactive learning style with peers or the instructor. Materials from the Discussion Forums and/or the Reading Assignments sometimes also emerge in the topic sessions, as time and interest dictate.

Esri Virtual Campus Modules – 3 for a total of 3 points. Students are required to demonstrate satisfactory completion of three Esri Virtual Campus modules regarding geodatbases by submitting their course completion certificates, which include the scores received for an Esri-authored quiz.

Geodata Tutorials – 3 for a total of 20 points. During the first 9 weeks of the class, you will be working on spatial data tutorials using ArcGIS Desktop on the GIST Server. Points will be awarded progressively as the tutorials are built-out, 3 points/week x 2 weeks for Tutorial 1, 3 points/week x 2 weeks for Tutorial 2, and 8 points altogether for Tutorial 3. In addition,

students are expected to offer each other advice and assistance on the tutorials through the Blackboard discussion board mechanism.

Final Project – 1 (with 4 components) for a total of 30 points. The final project will be your opportunity to integrate all that you have learned in the course by developing a prototype geodatabase with sample data and a supporting map display for a geographical topic of particular interest to you. Paired-projects are encouraged to share the intellectual discovery process that inevitably accompanies geodatabase development, as well as to accomplish more practical work in the time available (~4 weeks), i.e. collecting the appropriate spatial and non-spatial data, importing those data into a suitably designed Esri geodatabase, producing and interpreting maps, etc. Many final projects in SSCI 582 evolve into, or help shape, thesis proposals, too.

To help facilitate assessment of your final project, which is original and interpretive, the work will be broken up into four distinct components with their own points and deadlines as follows: (1) a single paragraph (250 word maximum) that describes the chosen topic (3 points), iterated in individual meetings with the instructor, for you to present and discuss your topic and to focus it appropriately (2 points); (2) a formal report (not exceed 2500 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 a demonstrative map (15 points); (3) a succinct (15-minute) oral presentation of your project (5 points); and (4) substantive questions on other students' presentations (5 points).

Careful planning and a serious, consistent commitment will be required for you to successfully navigate the various deliverables in this and other GIST courses. The table below summarizes the SSCI 582 course assignments and their point distribution:

Assignments	Number	Points Per Assignment	Total Points
Resume assignment	1	2	2
Discussion forums	4	4	16
Reading assignments	5	5 or 6	29
Topic sessions (optional)	8	0	0
Esri VC modules	3	1	3
Geodata tutorials	3	various	20
Final project components			
Proposal, iterated	1	5	5
Formal report	1	15	15
Oral/video presentation	1	5	5
Q&A of others' presos	3+	various	5
Totals	**30**	**-**	**100**

Grades in this and other GIST courses will use the standard USC grading criteria, as follows:

A	≥ 93 points	B-	80-82 points	D+	67-69 points
A-	90-92 points	C+	77-79 points	D	63-66 points
B+	87-89 points	C	73-76 points	D-	60-62 points
B	83-86 points	C-	70-72 points	F	< 60 points

It is important to note from the outset that: (1) 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 (2) no written work will be accepted for grading after 5:00 p.m. PT on the last day of classes.

Finally, I am a stickler for good writing and merciless about plagiarism. You must write your assignments in your own words, sentences, and paragraphs, and these must be free of typographical and grammatical errors (as MS Word will help you catch and correct). To Repeat: You must **not** copy other people's work (including web pages, books, and other students' work) to accomplish your assignments. For some assignments, it is tempting to just quote articles or webpages but please do not do it. I insist that you to read, process, and then write your own answers. I will not grade your assignment if it contains more than three (3) errors of diction (per MS Word), or if your document obviously contains non-original writing that is not referenced, or if it contains an excess of writing other than your own (in my judgment). Refer to the "Statement on Academic Integrity" section and check the website: http://plagiarism.org/

Requirements

Technology – Every student 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 telemeetings.
- A modern Web browser (Firefox recommended) to run ArcGIS, which is provided online via the GIST Server; you do *not* need to install it on your own computer.

Textbooks – There are two required texts for this course, available from the USC Bookstore or online outlets such as Amazon. Please note that the Yeung & Hall text is available through the USC Libraries as an e-Book. For each chapter of this text, GIST faculty have produced some Reading Notes to help you work through this material.

1. Young A K W and Hall B (2007) *Spatial Database Systems: Design, Implementation and Project Management*. The GeoJournal Library, 87, Springer, 553 pp. {eBook DOI: 10.1007/1-4020-5392-4_1; abbreviated "Y&H"}
2. Zeiler M and Murphy J (2010) *Modeling Our World: The Esri Guide to Database Concepts*, 2nd ed. Esri Press, 297 pp. {Hardcopy ISBN-13: 978-1589482784; abbreviated "Z&M"}

Readings – Additional readings, listed in the order they will be posted to Blackboard

1. Longley P F, Goodchild M F, Maguire D J and Rhind D W (2001) *Geographical Information Systems and Science* [1st ed.] Wiley, 454 pp. {Digital, Ch.3 (portion)}
2. Hunter G J (2002) Understanding semantics and ontologies: They're quite simple, really – If you know what I mean. *Trans. in GIS,* 6(2): pp.83-87. {Digital}
3. Kuhn W (2001) Ontologies in support of activities in geographical space. *Intl J. of Geog.*

Info. Sci. 15(7): pp.613-631. {Digital}

4. Schuurman N (2006) Formalization matters: Critical GIS and ontology research. *Annals of the Assoc. of Amer. Geographers*, 96(4): pp.726-739. {Digital}
5. Winter S (2002) Ontology: Buzzword or Paradigm Shift in GI Science. *Intl J. of Geog. Info. Sci.*, 15(7): pp.587-590. {Digital}
6. Smith B and Mark D M (2001) Geographical categories: an ontological investigation. *Intl J. of Geog. Info. Sci.*, 15(7): pp.591-612. {Digital}
7. Shekhar S and Chawla S (2003) *Spatial Databases: A Tour*. Prentice Hall, 262 pp. {Digital, Ch.3}
8. Couclelis H (1992) People manipulate objects (but cultivate fields): Beyond the raster-vector debate in GIS. In: Frank, Campari and Formentini, Eds. *Theories and Methods of Spatio-Temporal Reasoning in Geographic Space*, pp.65-77. Springer. {Digital}
9. Stonebraker M, with Moore D (1996) *Object-Relational DBMSs: The Next Great Wave*. Morgan-Kaufman, 216 pp. {Digital, Ch.1}
10. Zeiler M (1999) *Modeling Our World: The Esri Guide to Database Design* [1st ed.] Esri Press, 199 pp. {Digital, Ch.1}
11. Peuquet D J (1999) Time in GIS and geographical databases. In: Maguire, Goodchild, Rhind and Longley, Eds. *Geographical Information Systems: Principles and Applications*, 2nd ed. pp.91-103. Longman. {Digital}
12. Goodchild M F (2000) Communicating geographic information in a digital age. *Annals of the Assoc. of Amer. Geographers,* 90(2): pp.344–355. {Digital}

Web Trainings – There are four Esri Virtual Campus training modules supplied with this course, all to be covered in the first ten weeks. The first training is particularly extensive, of value to both neophytes with ArcGIS Desktop, and to GIS professionals as an update/refresher

1. Learning ArcGIS Desktop v10
2. Getting Started with Geodatabase (for v10)
3. Getting Started with Geodatabase Topology (for v10)
4. Working with Geodatabase Domains and Subtypes (for v10)

Communications – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). It is each student's responsibility to stay informed about course developments.

I will post on Blackboard Announcements and/or send via Blackboard email any notices that are time sensitive. Check the Announcements each time you log onto Blackboard, and read as soon as possible all email sent from Blackboard or by me personally. Check to be sure, too, that no such email goes into your junk folder. It is

While I am usually on-line and will probably respond to emails from students relatively quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 48 hours delay. In the rare case when I expect to be off-line for more than 48 hours, I will post an announcement on the Blackboard site.

All materials to be graded will be submitted via Blackboard, either in the discussion forums or by direct upload. If the forum or upload link is not present, your submission is late; contact me to make alternate arrangements for submission.

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.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to an instructor as early in the semester as possible. DSP is located in STU 301 and is open from 8:30 a.m.to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions can be found at: http://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

Important Administrative Dates

- 1/13: Spring semester classes begin
- 1/20: Martin Luther King Day, university holiday
- 1/31: Last day to register and add classes, change enrollment option to Pass/No Pass or Audit, purchase or waive tuition refund insurance, or drop a class without a mark of "W" and receive a 100% refund
- 2/17: Presidents' Day, university holiday
- 3/17-22: Spring recess
- 4/11: Last day to drop a class with a mark of "W"
- 5/2: Classes end
- 5/16: Commencement

Tentative Schedule

Week	Week Begins	Theme	Readings	Assignments due the following:				
				Monday	Wednesday	Friday	Week's Assignements and Practice topics	Final Project
1	13-Jan	Introduction - Current Status Spatial Information Tech.	Y&H1, Papers, Notes			R	P1 - eLibrary research - Area of interest for Final Project	**Resume**
2	20-Jan	Concepts of Database Systems	Y&H2-3, Papers, Notes	P1	D0		P2 - Semantics & Ontology	
3	27-Jan	Database Models and Data Modeling; ERD & UML (LucidChart)	Y&H3, Papers, Notes	P2			P3 - Database design; D1 - Fields & Objects	
4	3-Feb	Database design and SQL (for T1)	Papers, Notes	P3	D1		T1 – SQL Server	
5	10-Feb	Vector Spatial Data & Spatial Database Systems	Z&M3-4, Papers, Notes			T1	D2 – Time in Geodata	**Individual meeting**
6	17-Feb	Object-Orientation (for T2)	Papers, Notes		D2		T2 - Esri Geodatabases	
7	24-Feb	Raster Spatial Data & Spatial Database Systems	Z&M7, Papers, Notes			T2	P4 - Spatial data structures	
8	3-Mar	DB Design Document (for T3) – Part1	Papers, Notes				T3 - DB design document	
9	10-Mar	DB Design Document (for T3) – Part2; ArcGIS Diagrammer & X-Ray	Papers, Notes	P4			P5 - ESRI data models	**Proposal - Geodatabase Framework**
	17-Mar	*Spring Recess*						
10	24-Mar	Spatial Data Standards and Metadata	Papers, Notes	P5		T3	D3 - Spatial Data Mining -Part 1	**Progress Meeting**
11	31-Mar	Spatial Data Sharing, Data Warehousing	Y&H5, Papers, Notes				D3 - Spatial Data Mining -Part 2	
12	7-Apr	Spatial Database on the Cloud (CartoDB)	Y&H6, Papers, Notes		D3		D4 - Geodb Tools on the Cloud - CardoDB	
13	14-Apr	Future of Geodatabases	Papers, Notes					
14	21-Apr	Final Projects wrap up	Papers, Notes		D4			
15	28-Apr	Final Project		Report	Presentation	Video	Final Project Report, Presentation, Video	**Final Project Report, Presentation, Video**

D = Discussion (Blog), P = Paper, T = Tutorial