

## **GEOGR 5150/6150 Spatial Database Design for GIS– Fall 2004**

**Instructor:** Harvey J. Miller  
**Lecture meeting time and room:** MW 11:50 am – 1:10 pm OSH 106  
**Lab section and meeting time:** W 2:00 pm – 2:50 pm Beh S 101  
**Office hours and location:** MW 9:00 – 10:30 am OSH 270 or by appointment (don't be shy!)  
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### **TEXT**

Shekhar, S. and Chawla, S. (2002) *Spatial Databases: A Tour*, Prentice-Hall. Plus other readings online at the WebCT site.

### **COURSE DESCRIPTION AND OBJECTIVES**

*In 10 years, the ability to work with geographic information will have less to do with possession of a unique software package called "GIS" and much more to do with an understanding of how digital information of geographic phenomena are constructed, how information can be assembled and processed in massive distributed environments and how information can be passed freely from one environment to another.*

Michael Goodchild, NCGIA-Santa Barbara, (*GIS World*, vol, 10, no. 12, p. 42).

It is quite likely that “GIS,” as a unique software package that tightly couples spatial database management with spatial analytical and cartographic tools, will disappear within the decade. Emerging is a multi-layer, modular architecture that separates spatial database management from spatial analysis and cartography.

Why? First, most enterprises store their data in large database management systems and it is easier for GIS to migrate to data rather than vice versa. Second, spatial database management is entirely different than spatial analysis and cartography, and it is more effective to have separate software systems to support these different functionalities. Finally, uncoupling spatial data management from GIS allows the support of a much wider range of spatial applications. There is an evolving *geographic information services* industry that will dwarf the GIS industry in the near future.

The course will prepare you for your present and future career as a software designer, analyst or researcher who uses digital geographic data. During this semester, you will learn: i) how to model spatial data and design a spatial database; ii) how to query from a spatial database; iii) how to store spatial data within a computer; iv) how to optimize spatial queries to improve performance; v) how to design and query network databases; vi) how to perform exploratory analysis and data mining with large spatial databases; vi) future trends in spatial databases.

### **EVALUATION**

Examinations: 60% of the final grade

Assignments and class participation: 40%

### **EXAMINATIONS**

There is a lot of material to cover in this course, and much of this material may be unfamiliar to those without a background in computer science. Rather than one or two large midterms and a final, we will have smaller tests on a more frequent basis. This will make the examinations more manageable and less stressful (at least for the student!).

We will have an examination after completing each chapter of the text Examination dates will be announced in class and posted at the WebCT site (see below). Each examination will be worth an equal proportion of the overall examination portion of your grade.

Final Exam: Friday, December 17, 2004 10:30 am – 12:30 pm. (Sorry about the day – it's the university schedule, not mine. No, I can not change it.)  
The final is NOT comprehensive.

### **OTHER IMPORTANT DATES**

Last day to drop (delete) classes	Sept 3
Last day to add classes	Sept 7
Last day to elect CR/NC option or to audit a class	Sept 7
Last day to withdraw from term length classes	Oct 22
Classes end	Dec 9
Final exams	Dec 13-17
<b><u>University holidays</u></b>	
Labor Day	Sept 6
Fall Break	Oct 7-8
Thanksgiving Break	Nov 25-26

### **POLICIES**

- 1) Individual extra credit will not be assigned
- 2) An "incomplete" will be given only in extreme cases when conditions beyond the student's control require an extended period of absence. Even in this case, at least 80% of the course requirements must be completed.
- 3) Examinations must be taken during scheduled times announced in class and through WebCT. If you have a legitimate excuse (such as medical, family illness or unavoidable work conflicts), you must contact the instructor before the examination. If you do not contact the instructor before the examination you will not be able to make up the examination unless the circumstances were extreme and contacting the instructor was impossible.
- 4) Late assignments will be penalized 10% per day late and will not be accepted more than three days after the due date.
- 5) The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

### **WEB TOOLS**

This course has an online component using the University of Utah WebCT software. These tools provide access to online materials, course schedule and announcements as well as chat rooms, email and other novel ways for interacting with the instructor and other students. **You are responsible for all announcements, additional reading assignments and other material posted at the GEOGR 5150 WebCT site, so be sure to check it frequently.**

If you are registered for this course you are automatically registered for the WebCT site. See: <http://webct.utah.edu/>. You must logon to WebCT using your university Network ID (uNID). See <http://www.netcom.utah.edu/helpdesk/faq/nid.html> for information about UNID.

### **STUDY SUGGESTIONS**

1. **Read each reading assignment at least twice** – before the relevant lecture in class and after the lecture. The first read of the chapter will likely be difficult and you will probably have some confusion and questions. Don't worry! After the material is explained in lecture, the

second read will be much clearer and understandable.

2. **Bring the text and other readings to class.** I will refer to particular text, figures, algorithms and equations in the readings in lecture. Since you shouldn't sell the text back to the bookstore anyway, you may want to take some notes on the text itself.
3. **Review the lecture slides before class.** Lecture slides will be posted at the WebCT site. You may wish to download these slides and bring them to class (make sure you have a high bandwidth connection since the slides may be graphics-intensive).
4. **Study the "Exercises" at the end of each chapter early rather than later.** Be sure you understand the material and exercises as you go through the chapter, rather than waiting just before an examination.
5. **Talk to the instructor.** Confused? Not confused but interested in a particular topic? Talk to me. If you cannot make office hours please contact me and you will be cheerfully accommodated.

<b>Topic</b>	<b>Readings (Shehkar and Chawla)</b>
<b>1. <u>Introduction to Spatial Databases</u></b>	
Introduction	1-11
An overview of spatial databases	11-21
<b>2. <u>Spatial Concepts and Data Models</u></b>	
Models of spatial information	22-34
Three step database design	34-41
Extending ER models to include spatial concepts	41-45
Object-oriented data modeling	45-51
<ul style="list-style-type: none"> <li>• If you do not have a background in databases, read the Supplementary Notes on “Database Fundamentals” at the WebCT site prior to beginning this chapter.</li> </ul>	
<b>3. <u>Spatial Query Languages</u></b>	
Database query languages	52-55
Relational algebra	55-59
Structured Query Language (SQL)	59-64
Extending SQL for spatial data	64-71
Object-relational SQL	71-82
<b>4. <u>Spatial Storage and Indexing</u></b>	
Basic data storage concepts	83-96
Spatial indexing	97-104
Current trends	104-113
<b>5. <u>Query Processing and Optimization</u></b>	
Evaluation of spatial operations	114-122
Query optimization	122-128
Analysis of spatial index structures	129-132
Distributed spatial databases	132-138
Parallel spatial databases	138-148
<ul style="list-style-type: none"> <li>• If you do not have a background in algorithms and complexity analysis, read the Supplementary Notes on “Algorithms and Complexity” at the WebCT site prior to beginning this chapter</li> </ul>	
<b>6. <u>Spatial Networks</u></b>	
Network databases (examples)	149-151
Conceptual, logical and physical data models	151-157
Query languages for graphs	157-165
Graph algorithms	165-173
Access methods for spatial networks	173-181