

# Geography 676

## Web Spatial Database Development and Programming

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### Lectures

9:30AM - 10:45AM, Tuesday/Thursday, 360 Science Hall

### Labs

Tuesday 11:00 AM – 1:00 PM, Wednesday 6:00 – 8:00 PM, 380 Science Hall

### Course Overview:

Designing databases provides a foundation for GIS functions and web applications, which includes investigating techniques used for designing databases in non-spatial environments and learning the applicability to GIS problems. The first half of the course will cover the basic concepts, techniques and methodologies for designing and implementing a spatial database.

Within second half of the course, students will learn to program using object-oriented language, JAVA, to access, query, and manipulate data from the spatial database (Postgresql/PostGIS) on the server side. The student will also develop the capability of mapping those geospatial data using JSP and Google Map APIs. A comprehensive spatial database and programming training process including database design and manipulation, computer programming, programming syntax, data types, data structure, control structures, and an integrated programming environment (such as Eclipse and Tomcat) will be introduced and practiced during the lectures and lab sessions.

The main content of this course will include:

- Fundamental database concepts, benefits of using databases, functions of database management systems;
- Data modeling and database design: Entity-Relation diagrams; relational model;
- Usages of modern open-source (free) spatial databases products;
- Software development and Object Oriented Programming: JAVA programming fundamentals;
- Spatial database access, query and manipulation through programming

## Course Goals:

Upon the completion of the course, students are able to:

- Develop a strong conceptual understanding of database design and implementation in GIS;
- Use open source database software (Postgresql/PostGIS) to create and manage spatial databases;
- Use Structured Query Language (SQL) to create and manipulate databases;
- Develop the capability of programming using JAVA, JSP and JS;
- Design and develop a web portal to retrieve, manipulate, and visualize geospatial datasets from the database;
- Design and develop a spatial database and program to solve specific geographic information problems.

## Course Requirements:

It is required that students have taken at least one introductory GIS course (Geog 377 or Geog170), and programming course (Geog 378, Geog 575, or programming course provided by the computer science).

## Recommended Textbook:

### Database (Optional)

A. K. W. Yeung and G. B. Hall, *Spatial Database Systems: Design, Implementation and Project Management*. Springer, 2007.

S. Shekhar and S. Chawla, *Spatial databases: a tour*. Prentice Hall, 2003.

M.F. Worboys, and M. Duckham, *GIS: A Computing Perspective*, 2<sup>nd</sup> edition, CRC Press, 2004.

A. Silberschatz, H Korth and S. Sudarshan, *Database System Concepts*, 6/e. McGraw Hill. 2011.

### JAVA Programming (Optional)

Y. D. Liang. *Introduction to Java Programming, Comprehensive Version (9th Edition)*. Prentice Hall, 2012.

Additional reading materials will be distributed through the Learn@UW.

## Evaluation:

Your grade in this course is based on two exams, ten labs, several ad-hoc quizzes, and final project. The points assigned to each component are as follows:

Items	Percentage	Date
Exam#1	20%	03/11
Quizzes (6, dropping the lowest)	5%	ad-hoc
Lab (10)	30%	throughout
Exam#2	15%	04/29
Final project	30%	5/17 (noon)

**Quizzes:** Quizzes will be administered during any class period - immediately after a lecture, at the beginning or end of a class, etc. **Make-up quizzes will not be given at any circumstance, no exceptions.** However, the lowest quiz scores will be dropped.

**Lab:** You will complete ten lab assignments throughout the semester. Most labs will consist of exercises and small projects using open sources to practice and reinforce your understanding about database, and programming concepts. Plagiarism is not tolerated. As with other evaluated items, any offense results in a zero for the lab assignment and disclosure of the impropriety to the Department and University. Assignment must be submitted to *Learn@UW dropbox* prior to the start of class on the day it is due. **Late labs will be marked down 10% a day;** submission of an assignment the day it is due, but after the deadline (e.g., following your lab that day), counts as one day late. Technical complications (e.g., disk errors, printing problems) are not reason for extension; be sure to back up copies of all of your work and version meticulously, as forgetting to save and back up your interactive map is the easiest way to lose your work. Requests for grade changes must be submitted in writing (via email) within **24 hours** of receiving your feedback.

**Exams:** Exams include a combination of multiple choices, True/False, and short answer questions, with an emphasis on the latter. A review is provided one or two days prior to the exam. The exams are not cumulative. While group studying is encouraged, cheating during the exam is not tolerated and results in a zero for the exam and disclosure of the impropriety to the Department and University. Exam must be taken at the scheduled time and date. **Make-up exams will not be given unless prior arrangements have been made with the instructor.** Make-up exams require a doctor's note or, in the event of planned travel, must be rescheduled **4 weeks** in advance. Make-up exams are in an essay format, rather than primarily short answer.

**Term project:** A project that utilizes spatial database and programming technologies to solve problems is required. **A two page (double line) project proposal and a final**

**project report (~ 3000 words) are required by the due day.** Each project will be carried out in a group of **three** or **four** students; graduate students are allowed to work alone only if the project is a component of their thesis research. Students will be required to present your project to the class at the end of the semester. Guidelines of the term project presentation and report will be released during the semester.

**Grading criteria:**

- 90-100% A
- 87-89.9% AB
- 83-86.99% B
- 80-82.99% BC
- 75-79.99% C
- 70-74.99% DC
- 60-69.99% D
- < 60% F

**Additional Course Information:**

- ❖ Course information and copies of lecture material are disseminated in class or via the course website on Learn@UW. It is your responsibility to obtain this information and check the course website regularly. I intend to keep changes to the syllabus to a minimum, but do keep in mind that changes to the syllabus may occur. If changes are made, I will inform you in class and via the course website.
  
- ❖ A note on scholastic dishonesty: Academic honesty and integrity is expected at all times. All work, including assignments, quizzes and exams, must be completed individually by each student. It is expected that work submitted by a student reflects his or her original ideas and responses. Submissions that reflect substantially similar work by more than one student will be dealt with as an act of scholarly dishonesty and credit will be deducted from each assignment in question. Scholarly dishonesty includes: “cheating on an examination; collaborating with others in work to be presented, contrary to the stated rules of the course; submitting a paper or assignment as one’s own work when a part or all of the paper or assignment is the work of another; submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas...” Please refer to the “Student Academic Misconduct Policy & Procedures” document produced by Student Advocacy & Judicial Affairs division of the Offices of the Dean of Students for further information.
  
- ❖ A note on class etiquette: Cell phones must be silenced when you are in lecture. In addition, please refrain from reading the paper, participating in social conversations and other disruptive behavior (including frequenting Facebook or other social networks on your laptop) during lecture.

**Tentative Schedule:**

Week	Date	Topics/Lab	Readings	Assignment
1	01/21	Introduction	Ch1	
	01/23	Database fundamentals	Ch2	
	01/21, 22	PostgreSQL Tutorial I: GUI (pgAdmin III)		
2	01/28	DB design 1: Entity-Relation (ER) model	Ch3	
	01/30	DB design 1: ER diagrams		
	01/28, 29	Design an ER diagram using pgModeller		Lab#1 due
3	02/04	DB design 2: Relational DB concept	Ch3	
	02/06	DB design 2: Principles to build a relational DB		
	02/04, 05	PostgreSQL Tutorial II: Command line		Lab#2 due
4	02/11	Relational operations and algebra	Ch3	
	02/13	Structured Query Language (SQL)		
	02/11, 12	PostgreSQL Tutorial III: Create, read, update and delete (CRUD) data using SQL		Lab#3 due
5	02/18	Spatial database and design: Concept	Learn@UW	
	02/20	Spatial database and design: Principles and steps		
	02/18, 19	ESRI Geodatabase tutorial: Design and implement a relational DB		Lab#4 due
6	02/25	Spatial query	Ch4	
	02/27	Spatial storage and indexing		
	02/25, 26	PostGIS Tutorial I		Lab#5 due
7	03/04	Spatial query optimization	Ch4	Group formed
	03/06	Spatial database issues, management and administration	Ch 7, 8, 9	
	02/04, 05	PostGIS Tutorial II		Lab#6 due
8	03/11	<b>Midterm (75 minutes)</b>		
	03/13	JAVA Language and programming		
	03/11, 12	JAVA & Eclipse exercise		Lab#7 due
9	<b>Spring Break</b>			
10	03/25	JAVA Syntax, Class, Object		
	03/27	JAVA Control, IO		
	03/25, 26	Program for retrieving tweets with Twitter API		Lab#8 due
11	04/01	JDBC for DB access		Project proposal due
	04/03	JAVA for data retrieval and manipulation		
	04/01, 02	Program for archiving tweets to Postgresql / PostGIS DB		
12	04/08	WebGIS development I: Client (JS )		Lab#9 due
	04/10	<b>AAG</b>		
	04/08, 09	HTML and JS exercise		
13	04/15	WebGIS development I: Web mapping and visualization		
	04/17	WebGIS development II: C/S interaction (JSP)		
	04/15, 16	Dojo + Leaflet framework practice		
14	04/22	WebGIS development III: Server side		
	04/24	WebGIS development IV: Spatial web database		
	04/22, 23	Developing a web portal for accessing, querying, and visualizing tweets		Lab#10 due
15	04/29	<b>EXAM #2: 75-minute final (non-cumulative)</b>		
	05/01	Project presentation format and misc.		
	04/29, 30	Final project consultation workshop		
16	05/06	Open Work Period; Workshop Final Projects		
	05/09	Final Project Presentations and Class Discussion		
	04/06, 07	Final Project Presentations and Class Discussion		
17	5/17	Final project report, video submission		Projects due