

# GTECH 38519

## Geospatial Databases

Fall 2019, Wednesday 5:35 - 8:25 PM at HN 1090B-2

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### Course Description and Objectives

Geospatial data, including their acquisition, cleaning, formatting, management, maintenance, update, and dissemination, are at the core of most real-world GIS and serve as the foundation for further visualization and analysis. On average, eighty percent of the cost of a GIS project is on geospatial data. Therefore, learning to design, create, populate, optimize, and maintain geospatial databases is critical to GIS users and geospatial professionals. This course is intended for students who want to learn the knowledge and skills of creating, querying, and managing spatial databases. More specifically, students will learn general relational databases and SQL (Structured Query Language) first. Then, spatial databases, particularly the open-source Postgres/PostGIS, will be introduced along with ST-SQL that allows spatial queries and analyses. Related to these spatial database operations, students will also learn the methods of cleaning spatial data, checking their qualities, and loading them into a spatial database. The course has four task-oriented lab assignments, one mid-term exam, and one final group course project (one from four options: micro population data from census and NLCD, NYC MapPLUTO, TIGER-based NYC Geocoder, and pgRouting for NYC).

### Learning Outcomes

At the end of the semester, students should be able to

- describe the basic concepts of general and spatial databases
- compose SQL statements to interact with (object-)relational databases
- pre-process spatial data and import data into PostGIS to build spatial databases
- perform basic spatial query, data manipulation, data export, and spatial analysis using spatial-type SQL

### Pre-requisite

**GTECH 20100: Introduction to Geographic Information Science**, preferably also GTECH 36100: GIS Analysis.

### Course Materials

Required Textbook:

- Obe, Regina O., and Leo S. Hsu. *PostGIS in Action* (2nd ed.): Manning, 2015.

Recommended Books:

- Mikiewicz, D., M. Mackiewicz, and T. Nycz. 2017. *Mastering PostGIS*: Packt Publishing.
- Lembo, A.J. 2015. *How Do I Do That in PostGIS: Illustrating Classic GIS Tasks*: CreateSpace Independent Publishing Platform.

## Course Calendar & Content

Week	Session	Date	Topic	Deliverables
1	1	08/28	Introduction: Relational, Object-Relational, and Spatial Databases (Chapter 1)	
2	2	09/04	SQL Primer with MS Access: Query, SQL SELECT, JOIN, GROUP BY, Table and View, Form and Report (Appendix C)	
3	3	09/11	SQL with PostgreSQL: Update, Insert, Delete, Schema, Database, Table, View, pgAdmin (Appendix C, B, D, Chapter 1)	Lab1: SQL Basics
4	4	09/18	Spatial Databases and PostGIS: extensions, geometry, geography, geometry types and functions, reference systems (Chapter 1, 2, 3)	
5	5	09/25	Data Cleaning and Spatial Database Construction: import, export, load, clean, quality-check (Chapter 4)	
6	6	10/02	Desktop GIS and Spatial Databases: Connect to PostGIS from QGIS and ArcGIS (Chapter 5)	Lab 2: PostGIS Basics
7		10/09	<i>No Classes Scheduled</i>	
8		10/16	<i>Follow Monday Schedule</i>	Course Project Planning/Proposal
9	7	10/23	Spatial Data Organization: geometry types and columns, spatial reference systems (Ch. 6, 12)	
10	8	10/30	Spatial SQL I: Basics (Chapter 9, 10)	
11	9	11/6	Spatial SQL II: Spatial Query (Chapter 10, 11)	
12	10	11/13	Spatial SQL III: Spatial Analysis (Chapter 11)	Lab 3: Spatial Query /w ST-SQL
13	11	11/20	<i>Exam</i>	
14	12	11/27	Database Management and Performance Tuning (Chapter 14, 15)	Lab 4: Spatial Analysis /w ST-SQL
15	13	12/4	Spatial Database for Raster (Chapter 12)	Project Progress Report
16	14	12/11	Synthesis and Project Development	
17	15	12/18	Project Presentations	Project Presentation
		12/20	Last Day of the Semester	Final Project Database/Paper/Poster

## Software

- Microsoft Excel and Access (part of MS Office) and Connectors to PostgreSQL
  - Npgsql: .Net Data Provider for PostgreSQL (Free and Open Source)
    - <https://github.com/npgsql/npgsql>
    - <https://github.com/npgsql/Npgsql/releases>
  - ODBC for PostgreSQL (Free and Open Source)
    - <https://odbc.postgresql.org/>
    - <https://www.postgresql.org/ftp/odbc/versions/msi/>
- PostgreSQL and PostGIS (Free and Open Source)
- QGIS (Free and Open Source)
- ArcGIS Pro 2.x or ArcGIS 10.6 and above (available in the Geography Lab and for all CUNY students)

## Grading Method & Scale

Evaluation of academic performance is based on the following components and breakdowns.

Lab exercises	30%
Exam	30%
Participation	10%
Project Proposal	5%
Project Progress Report	5%
Project Presentation	10%
Project Report	10%

Numeric scores will be used throughout the semester. The course letter grade will be determined only at the end of the semester, although guidance as to letter grade standing will be given along the way.

Assignments are due six days after given in class. It is in your best interests to meet deadlines for assignments. In general, incomplete grades and time extensions are not an option for this course. There are no "extra-credit" assignments. Unless otherwise instructed, you will submit assignments in electronic forms through BlackBoard.

To gain practical skills, lab exercises are also required for this course. Lab exercises may also include reading questions related to the core concepts or techniques discussed in the lecture. All labs assignments are designed at about 4-hour per week workload on average for those who have the necessary basic GIS skills. It is not uncommon for some who need to spend significantly more time on lab works due to their training in GIS basics or their choice of working out problems on their own instead of asking the instructor questions timely. It is strongly recommended to allocate your time evenly on assignments. For example, one hour every day is much better than six hours in a single day. Students in the class are strongly encouraged to install required software on their own computers. The computer labs are open 24/7 and all students can use the computer labs at any time outside of the posted instruction times for other courses.

Each of the students in the class will need to conduct an individual, semester-long course project that involves the analysis of a substantial geographical or spatial problem. There are no requirements with respect to software. In a similar vein, the application area (field) is also the choice of each student. Everyone in the class is also responsible for gathering the necessary data for her or his own project. Essentially, students can choose whatever topic, provided it has to do with geographical analysis. Note that each student in the class is fully responsible for her or his own project, for which the instructor will help evaluate its feasibility. A few ready-made projects are available, but experience shows that motivation increases when students take pride in their own projects.

### ***Incomplete (IN) and Credit***

The instructor cannot accommodate students who are late in their work or do not show up for the exam or presentation. And, unless you produce a medical certificate or letter from the Office of Accessibility, the instructor will not give the final grade of IN (incomplete). Graduate students are not eligible for Credit/No Credit as a final grade.

## **Policies**

### ***Attendance***

Attendance is crucial. Given that the class-learning environment is active learning, meaning that most your performance is practical assignments rather than tests, adherence to protocols and the course timetable is very important. I will be on time. So you will also be on time. It's just common courtesy. Lateness in arriving at class, both lectures and laboratory/discussion sections will not be tolerated. Active involvement in the course is evidenced in part by undertaking the mechanics of the practical assignments systematically, and learning the tools by hours of practice. In so doing the tools soon come to be seen as a means to an end, rather than the end themselves. For example, you will make many maps, and may get caught up in this creative activity, but remember that the maps are being made for particular scientific purposes. Class participation includes timely attendance at laboratory sessions, participation in organized class discussions, accomplishments of in-class tasks, accomplishment of the preliminary assignment on time, and participation in the map poster display (if this is a part of the course this semester). Remember that a good part of your grade depends on class participation. Of course, you are expected to behave respectfully towards the instructor and the other students, by not imposing a dominating or threatening presence in conversations and discussions, and by allowing others to speak and be heard, especially if they are shy and their voice weaker than yours.

### ***Electronics in the classroom***

Electronic recording devices are allowed during lectures. All other personal electronics should be turned off before coming into the classroom. This includes cell and smart phones. Computers may be used for taking notes and doing the lab exercises, and if you use them for activities not related to classroom content (personal e-mails, Facebook chats, surfing the Internet for fun ...), you will be asked gently, but firmly, to turn them off.

### ***Course Website***

*Web-enhancement* in the context of this course means that everything pertaining to this course will be communicated through BlackBoard. You are required to check the BlackBoard

course site on a daily basis. All changes to the syllabus will be announced on the course home page. All lecture and lab materials are accessible through [BlackBoard](#), and Blackboard is also the place where you upload your assignments. Your exams and lab assignments will be graded based on what you have uploaded to BlackBoard and that is where you will find your grades and may access course statistics that help you to assess your standing at any given time.

### ***Communication***

All email messages about this course should be signed with your full name as it appears in CUNYfirst. [Professionalism](#) and "[netiquette](#)" are expected in the communication through emails (check out those links). If your emails are not replied to in a timely fashion, please consider rewriting your emails in a better way.

### ***General Lab Policies***

*Lab policies* are described in detail in <http://www.geo.hunter.cuny.edu/techsupport/rules.html>.

### ***Hunter College Policy on Academic Integrity***

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

### ***ADA Policy***

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the Office of AccessABILITY, located in Room E1214B, to secure necessary academic accommodations. For further information and assistance, please call: (212) 772-4857 or (212) 650-3230.

### ***Hunter College Policy on Sexual Misconduct***

In compliance with the CUNY Policy on Sexual Misconduct, Hunter College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the Bill of Rights for Hunter College.

- a. Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College's Public Safety Office (212-772-4444).
- b. All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College's Title IX Campus Coordinator, Dean John Rose ([jtrose@hunter.cuny.edu](mailto:jtrose@hunter.cuny.edu) or 212-650-3262) or Colleen Barry ([colleen.barry@hunter.cuny.edu](mailto:colleen.barry@hunter.cuny.edu) or 212-772-4534) and seek complimentary services through the Counseling and Wellness Services Office, Hunter East 1123.

CUNY Policy on Sexual Misconduct Link:

<http://www.cuny.edu/about!administrationloffices/Ja/Policy-on-SexualMisconduct-12-1-14-with-links.pdf>

## **Syllabus Change Policy**

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice. Changes will be announced in class and on Blackboard, which students are expected to check regularly during the semester.