GEOG 580: Data Management for GIS
Spring 2024, Units: 3

Instructor
Atsushi Nara, Ph.D.
Email: anara@sdsu.edu
Office: 311C Storm Hall
Office hours: Wed. 9:30-10:30
or by appointment

Course Schedule
MW 14:00-14:50 (SH324, Lecture)
MW 15:00-15:20 (SH324, Lab)

Teaching Assistant
Jessica Embury
Email: jembury8568@sdsu.edu
Office: 301A Storm Hall
Office hours: by appointment

Instructional Mode
Face-to-face, Lectures & Labs

Platform
Canvas

Course Description
This course is designed to introduce students to data management for GIS (Geographic Information Systems) using open-source databases, primarily focusing on PostgreSQL and PostGIS, an open-source object-relational database and a spatial database extender for PostgreSQL, respectively. The use of Open Source Software (OSS) is a continuing trend in big geospatial data mining and knowledge discovery, location-based services, and GIS application development. This course is aimed at undergraduate and graduate students who have a basic understanding of GIS, GIS software, and computer programming and are interested in learning open-source databases useful for storing, querying, and managing large geospatial datasets. Knowledge of databases is a highly desirable skill for big data analysis and geospatial application development in the field of GIS.

This course includes lectures, demos, hands-on exercises, and database projects. The course covers database fundamentals and techniques necessary for designing, implementing, managing, and querying geospatial data stored in open-source databases. Specific topics include relational database and spatial database design, Structured Query Language (SQL), and spatial query in PostgreSQL and PostGIS. In addition, this course will briefly introduce ways to integrate PostgreSQL and PostGIS with GIS software and programming languages such as QGIS, ArcGIS, R, and Python for geospatial data management, analysis, and visualization.

Student Learning Outcome
By the end of this course, students will be able to:
- Apply the fundamental database concepts, structures, techniques, and approaches to design, implement, and manage geospatial data in databases.
- Analyze given geospatial data stored in a database using Structured Query Language and identify spatial patterns of the data.
- Perform GIS operations within databases for geospatial data management and analysis.
- Evaluate and improve the performance of database queries.
- Construct geospatial research questions and answer them by developing a geospatial database with your own data, querying the database, examining query results, and reporting the outcome.

Prerequisites
{GEOG 381 or GEOG 484} and {GEOG 383, CS107 or CS108} or graduate standing.

Books and Materials
Optional: Obe, R., & Hsu, L. Second Edition (2015). *PostGIS in action*. Manning Publications Co.
https://csu-sdsu.primo.exlibrisgroup.com/permalink/01CALS_SDL/r45sar/alma991071823214002901
* Free eBook: need to log in with your SDSUid.

3rd Edition (2021)
https://csu-sdsu.primo.exlibrisgroup.com/permalink/01CALS_SDL/r45sar/alma991073258475802901
* Free eBook: need to log in with your SDSUid.

Optional: Silberschatz, A., Korth, H. F., & Sudarshan, S. (2009). *Database system concepts, 6th edition*. New York: McGraw-Hill.
Optional: Shekhar, S. and Chawla, S. (2003). *Spatial Databases: A Tour*. Prentice Hall.

Grading
A higher standard and weight will be applied to the final project for graduate students.

	Undergraduate	Graduate
Lab Exercises	50%	40%
Participation	10%	10%
Midterm Exam	15%	15%
Final Project	25%	35%

Percent	Letter
97 - 100	A+
93 - 96.99	A
90 - 92.99	A-
87 - 89.99	B+
83 - 86.99	B
80 - 82.99	B-

Percent	Letter
77 - 79.99	C+
73 - 76.99	C
70 - 72.99	C-
67 - 69.99	D+
63 - 66.99	D
60 - 62.99	D-
< 60	F

Letter Grade	Grade	Achievement
A	4.0	Outstanding achievement
B	3.0	Praiseworthy performance
C	2.0	Satisfactory performance
D	1.0	Minimally passing
F	0.0	Failing

Lab

Lab sessions give students hands-on exercises in spatial database management. All exercises are based on materials covered in lectures and involve some aspect of spatial database management and/or geospatial data queries related to GIS tasks. There will be 8 lab assignments. Both undergraduate and graduate students have the same assignment tasks; however, graduate students will receive lower scores (5% each) for their weekly lab assignments and be assigned a higher-level task on their final projects (see the paragraph on the final report below).

8 lab assignments

Undergraduate:	8 assignments × 6.25% = 50%
Graduate:	8 assignments × 5% = 40%

Class Participation

Class participation is based on each student's contribution to class throughout the semester. Students are expected to attend and actively participate in lectures and labs. 10% of the participation grade is based on; class attendance (2%), pop quizzes (4%), and discussion during class and project presentation (4%).

Midterm Exam

The midterm exam is built upon the material covered in previous lectures, labs, and assignments.

Final Project

General instructions will be provided for the final project. Students will be required to creatively design and implement a database and/or develop a GIS application that uses a spatial database. The final project will be evaluated based on a one-page project proposal, database implementation, project presentation, and final report. It is recommended that students consult with the instructor on selecting topics and problems at the earliest opportunity.

Database implementation for the final project is required and will be evaluated on **Monday, 04/29, 2024**.

The final project presentation slides and report should clearly describe the following topics, including but not limited to the research/project background, problem statement, research/project objectives regarding database management, database design, approach/method, SQL syntax, query performance, integration with other programming scripts (e.g., Python, R), result, major accomplishments, technical challenges, and/or references.

Along with the final presentation slides, undergraduate students are required to submit a 1-page summary report, whereas graduate students are required to submit a 5-page detailed final report describing topics mentioned in the above paragraph.

All lab assignments and course projects must be completed individually. Late submissions will not be accepted unless a valid excuse is presented to Prof. Nara prior to the due date (e.g., medical, family emergency, university-related field trip).

Weekly Topics

Week	*Date*	*Lecture & Lab Topics*	*Assignment*
1			
	01/17	Course Introduction	
2	01/22	Database Fundamentals & Intro. PostgreSQL	A1 dist.
	01/24		A2 dist.
3	01/29	PostgreSQL & Structured Query Language I	A1
	01/31		A2 due; A3 dist.
4	02/05	PostgreSQL & Structured Query Language II	
	02/07		A3 due; A4 dist.
5	02/12	DB design: Entity-Relation model	
	02/14		A5 dist.
6	02/19	Working on A4 & A5	A4 due.
	02/21	A5	
7	02/26	A5	A5 due.
	02/28	Query Performance & Index	A6 dist.
8	03/04	A6	
	03/06	A6 Solution; Midterm Exam Review	A6 due (before class)
9	03/11	Midterm Exam	
	03/13	PostGIS & Spatial Query I	A7 dist.
10	03/18	PostGIS & Spatial Query II	
	03/20		A7 due; A8 dist.
11	03/25	PostGIS & Spatial Query III	
	03/27		A8 due.
12	04/01	Spring Break	
	04/03		
13	04/08	Final Project Intro. & Prep.	
	04/10		FP Proposal due
14	04/15	AAG 2024 Conference/Final Project Prep.	
	04/17		
15	04/22	Final Project Prep.	
	04/24		
16	04/29	Final Project Presentation 1	FP Database Evaluation
	05/01	Final Project Presentation 2	**Final Project Due** Friday 05/03 @ 23:59:59

*The course topics and schedule may change due to various circumstances. You are responsible for any announcement made during class, even if you were absent.

Copyright Policy

SDSU respects the intellectual property of others and we ask our faculty and students to do the same. It is best to assume that any material (e.g., graphic, HTML coding, text, video, or sound) on the Web is copyrighted unless specific permission is given to copy it under a Creative Commons License. More information about the use of copywritten material in education as part of the TEACH Act and Copyright Fair Use Guidelines. Whenever possible, you should attribute the original author of any work used under these provisions.

Course Materials

All lecture slides, lab exercises, quizzes, and assignments created by the course instructor available via Canvas are copyrighted. ***These course materials are for the student's academic use only and should not be distributed in any manner to any other individual (No Redistribution Policy)***.

Audio/Video Recordings

Students may not record (audio or video) in this class except in accordance with ADA accommodations. Any recordings made in connection with a disability accommodation are for the student's personal academic use only and may not be distributed in any manner to any other individual.

Academic Honesty

The University adheres to a strict policy prohibiting cheating and plagiarism. Examples of academic dishonesty include but are not limited to:

- Copying, in part or in whole, from another's test or other examination;
- Obtaining copies of a test, an examination, or other course material without the permission of the instructor;
- Collaborating with another or others in coursework without the permission of the instructor;
- Falsifying records, laboratory work, or other course data;
- Submitting work previously presented in another course, if contrary to the policies of the course;
- Altering or interfering with grading procedures;
- Assisting another student in any of the above;
- Using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work);
- Copying and pasting work from an online or offline source directly and calling it one's own;
- Using information found from an online or offline source without giving the author credit;
- Replacing words or phrases from another source and inserting one's own words or phrases.

Unauthorized recording or dissemination of course instruction or materials by students, especially with the intent to disrupt normal university operations or facilitate academic dishonesty, is a violation of the Student Conduct Code. *This includes posting exam problems or questions to online platforms.* Violators may be subject to discipline.

The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion.

Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner.

Use of AI Generative Tools for "written" assignments

Any use of generative AI (like ChatGPT) for written assignments (i.e., Final Project Proposal & Final Report) may constitute academic dishonesty and be subject to discipline under the terms of the SDSU Student Code of Conduct.

Use of AI Generative Tools for "programming" assignments

For the SQL assignments in this course, the use of AI-based assistance, such as ChatGPT, is **allowed** and **encouraged** for "SQL assignments"; however, you should be aware of the concerns regarding *privacy* (e.g., link) and *veracity* (e.g., link). We treat AI-based assistance the same way we treat collaboration with other people: you are welcome to talk about your ideas and work with other people, both inside and outside the class, as well as with AI-based assistants. Nevertheless, ***all work you submit must be your own***. You should never include in your assignment anything that was not written directly by you without proper citation (including quotation marks, in-line citation for direct quotes, and your prompt messages used in AI-based assistance tools). Including anything you did not write in your assignment without proper citation will be treated as an academic misconduct case.

Online resources and AI-based assistance tools citation examples:

-- Adapted codes from stackoverflow (2024)
-- stackoverflow (2024, Jan. 17). "Best way to select random rows PostgreSQL"
-- https://stackoverflow.com/questions/8674718/best-way-to-select-random-rows-postgresql

-- OpenAI. (2024, Jan. 17). "SQL syntax for selecting the first 3 rows in PostgreSQL"
-- ChatGPT [GPT-3.5]. https://chat.openai.com

Furthermore, please do not copy the entire assignment questions/problems and paste them directly as your prompt message in the AI-assistance message box. Instead, identify the specific part of the questions you need assistance with and ask the question using your own words, which helps you improve your understanding of the subject. In addition, as your messages will be stored in the AI-based assistance database, this can facilitate academic dishonesty and violate the "***No Redistribution Policy***".

If you are unsure where the line is between collaborating with AI and copying from AI, we recommend the following heuristics:

- Never hit "Copy" within your conversation with an AI assistant. You can copy your own work into your conversation, but do not copy anything from the conversation back into your assignment. Instead, use your interaction with the AI assistant as a learning experience, then let your assignment reflect your improved understanding.
- Do not have your assignment and the AI agent itself open on your device at the same time. Similar to above, use your conversation with the AI as a learning experience, then close the interaction down, open your assignment, and let your assignment reflect your revised

knowledge. This heuristic includes avoiding using AI assistants that are directly integrated into your composition environment: just as you should not let a classmate write content or code directly into your submission, so also you should avoid using tools that directly add content to your submission.

Deviating from these heuristics does not automatically qualify as academic misconduct; however, following these heuristics essentially guarantees your collaboration will not cross the line into misconduct.

In addition, ***if a student's work is substantially identical to another student's work, that will be grounds for an investigation of plagiarism regardless of whether the prose was produced by an AI assistant or not***.

Classroom Conduct Standards

SDSU students are expected to abide by the terms of the Student Conduct Code in classrooms and other instructional settings. Violation of these standards will result in referral to appropriate campus authorities. Prohibited conduct includes:

- Willful, material, and substantial disruption or obstruction of a University-related activity, or any on-campus activity.
- Participating in an activity that substantially and materially disrupts the normal operations of the University or infringes on the rights of members of the University community.
- Unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.
- Conduct that threatens or endangers the health or safety of any person within or related to the University community, including:
    - Physical abuse, threats, intimidation, or harassment.
    - Sexual misconduct.

Land Acknowledgement

For millennia, the Kumeyaay people have been a part of this land. This land has nourished, healed, protected and embraced them for many generations in a relationship of balance and harmony. As members of the San Diego State University community, we acknowledge this legacy. We promote this balance and harmony. We find inspiration from this land, the land of the Kumeyaay.

Notes

The course syllabus and schedule may change due to various circumstances. You are responsible for any announcement made during class, even if you were absent.