GRG 356T

Fall 2025

Course Information

Instructional Mode: Face-to-face
Meeting Times: Tue/Thu 11:00 AM - 12:30 PM
Meeting Location: RLP 1.402
Unique Number: 38553

Additional Sections:

Instructor

Yuhao Kang
Email: yuhao.kang@austin.utexas.edu

Office Hours and Location

Instructor Office Location: RLP 3.422

Instructor Office Hours: T/W 10 - 11 am, by appointment

Teaching Assistants

Brody Manquen <bwm866@my.utexas.edu>
Office Location: RLP 3rd Floor Geography Dept Cubicle 7
Office hours: W 1-3 PM

Overview of the Class

Welcome to Spatial Data Science and Maps! This course is designed to equip students with knowledge and skills in spatial data science and behavior data science, spatial analysis, environmental psychology, and mapping. Topics in this course include but are not limited to theories of Spatial Data Science (SDS), Geographic Information System (GIS) modeling, Geospatial Artificial Intelligence (GeoAI), spatial analysis, environmental psychology, maps and visualizations. At the end of the semester, students will be proficient in creating, analyzing, and interpreting spatial models to solve complex geographic and environmental challenges (e.g., human mobility, environmental psychology, climate change, public health, and food security). Students will gain hands-on experience in using Python to model geographic environments, analyze spatial relationships, create visualizations, and make informed decisions based on geospatial data. Specifically, students will collect geospatial datasets with API and web scraping, perform GIS modeling including spatial autocorrelation, regression analysis, network analysis, clustering analysis, etc., using machine learning and GeoAI for solving geographic problems, and create interactive visualizations and dashboards. Students will also learn basic concepts in data governance and ethical implications of emerging technologies. These skills will not only empower students to make informed decisions driven by geographic data, but also help their future careers in data science and AI.

Pre-Requisites for the Course

Prerequisite: Varies with the topic.

Learning Outcomes

At the conclusion of this course, students will be able to:

- Understand the fundamental concepts in spatial data science, GeoAI, environmental psychology, and visualization;
- Understand the characteristics involved in developing computational models and analytical methods for spatial big data;
- Know the ethical challenges in data collection, management, processing, analyzing, and governance;

- Be familiar with Python programming for (spatiotemporal) data analysis, machine learning, and GeoAI tasks;

- Apply spatial data science, GeoAI, and visualization for informed decision making in real-world practices.

Generative Artificial Intelligence

The creation of artificial intelligence tools for widespread use is an exciting innovation. These tools have both appropriate and inappropriate uses in classwork. The use of artificial intelligence tools (such as ChatGPT) in this class is permitted for students who wish to use them, **provided the content generated by AI is properly cited and acknowledged.**

Grading Policy

Grading policy

Labs	50%	10 labs, 5% each
Exam	10%	1 final exam
Attendance	5%	Lab attendance is mandatory
Discussion	10%	10 discussion questions, 1% each
Presentation	5%	1 presentation for each group
Final Project	20%	1 group final project

Grade Breaks

Grade	Cutoff
A	94%
A-	90%
B+	87%
B	84%
B-	80%
C+	77%
C	74%
C-	70%

Grade	Cutoff
D+ D D-	67% 64% 60%
F	<60%

Overview of all Major Course Requirements and Assignments

Labs The labs are designed to provide students with hands-on experience with Python, spatial data science and GeoAI methods, and visualization techniques introduced in lectures. These tasks allow you to consolidate your understanding and apply theories to real-world geographic problems (e.g., urban mobility, accessibility, environmental data). Submissions are typically due one week after the lab is assigned. Late submissions will incur a penalty of 5% per day. Collaborative discussion of concepts is encouraged, but each student must submit their own original code and explanations. Code should be clearly commented to explain methods and reasoning. No work accepted 1 week after due date. Please contact the TA for emergency accommodations.

Exams There will be one comprehensive final exam at the end of the semester. The exam will cover material from lectures, labs, and discussions, testing both conceptual understanding and applied problem-solving in spatial data science and visualization. No programming questions will be tested. The exam is closed-book and must be taken in person on the scheduled date. No make-up exams will be provided.

Class attendance Attendance is mandatory for the lab sessions. There is one free absence. After this first absence, all labs submitted without attending the relevant session will automatically receive a 5% penalty. If you are sick or have an emergency, please contact the TA for accommodation.

Discussion questions There are 10 discussion questions in the course that are closely related to topics covered in the lecture. Students are expected to submit their responses on Canvas by the end of the week as the lecture.

Presentation Each student group will prepare and deliver one presentation during the semester. The presentation should explore a real-world application of spatial data science, drawing on one or more research papers, projects, or case studies. Groups must submit references at least one week prior to the presentation. All other students are expected to review the reference and prepare at least one discussion question. Presentations should demonstrate both technical application and broader insights into how spatial data science can inform real-world decision-making.

Final Project The final project is a group assignment that synthesizes the skills and knowledge gained throughout the course. Each team will design and carry out an independent project

applying spatial data science and visualization to a real-world urban or environmental challenge. Deliverables include: (a) a written report of no more than 6 pages (modeled on professional articles, e.g., *Transactions in GIS*), (b) a representative figure illustrating key findings, and (c) a storymap for the final project. The project grade will reflect both the written report and the group presentation. Group members will receive the same grade, so equitable participation is expected.

Required Course Materials

Urban Informatics
ISBN: 9789811589836
Authors: Shi, W., Goodchild, M.F., Batty, M., Kwan, M.P. and Zhang, A. eds.
Publisher: Springer Nature
Publication Date: 2021

Geographic Data Science with Python
ISBN: 9781032445953
Authors: Sergio Rey, Dani Arribas-Bel, Levi John Wolf
Publisher: Chapman and Hall/CRC

Handbook of Geospatial Artificial Intelligence
ISBN: 9781032311661
Authors: Song Gao, Yingjie Hu, Wenwen Li
Publisher: CRC Press

Recommended Course Materials

McKinney, W., 2012. *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython*. " O'Reilly Media, Inc.".

VanderPlas, J., 2016. *Python data science handbook: Essential tools for working with data*. " O'Reilly Media, Inc.".

Final Exam Date and Time

The final exam will be held on Nov. 18, 2025

A Notice of Academic Accommodations from Disability and Access (D&A)

The university is committed to creating an accessible learning environment consistent with university policy and federal and state law. Please let your instructors know if you experience any barriers to learning so they can work with you to ensure you have equal opportunity to participate fully in your courses.
If you are a student with a disability, or think you may have a disability, and need accommodations please contact Disability & Access (D&A).
Please refer to the D&A website. for more information. If you are already registered with D&A, please deliver your Accommodation Letter to your instructors as early as possible in the semester so you can discuss together your approved accommodations and needs in your courses.

University Policies and Resources for Students Canvas Page

This Canvas page is a supplement to all UT syllabi and contains University policies and resources that you can refer to as you engage with and navigate your courses and the university.

How Will You Learn?

Teaching Modality Information

This course is primarily conducted in person, requiring attendance at scheduled class times as published in the Course Schedule. All lectures and laboratory sessions will take place in designated classrooms and labs. Students are expected to be present physically for each class to participate in interactive discussions, group learning projects, and hands-on activities. Please note that this course does not offer remote participation options, and attendance is mandatory for successful completion.

Communication

The course Canvas site can be found at utexas.instructure.com. Please email me through Canvas. You are responsible for ensuring that the primary email address you have recorded with the university is the one you will check for course communications because that is the email address that Canvas uses.

Asking for help

If you have questions or need assistance with course materials, please ensure you direct your inquiries to the appropriate person for timely and effective support. For lecture-related questions, contact the Instructor directly either by email or during office hours. For lab-related inquiries, please reach out to one of the two designated Teaching Assistants (TAs). We strongly encourage you to make use of office hours to discuss course content, seek clarification on assignments, and engage in further discussions about GIS topics.

Late Work and Making up Missed Work

Students are expected to complete all assignments by the due dates. However, if you anticipate or encounter situations such as serious illness, family emergencies, or other valid reasons that prevent you from submitting on time, please notify Prof. Kang and via Canvas for extensions. Late work will be accepted with a penalty. Assignments submitted late will incur a grade reduction of 10% per day past the due date.

Sharing of Course Materials is Prohibited

No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class without my explicit, my written permission. Unauthorized sharing of materials may facilitate cheating. The University is aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in initiation of the student conduct process and include charge(s) for academic misconduct, potentially resulting in sanctions, including a grade impact.

Course Outline

This is a tentative schedule and may change based on progress.

Week	Date	Day	Lecture	Lab
1	26-Aug 28-Aug	T Th	Introduction	No Lab
2	2-Sep 4-Sep	T Th	Spatial Data	Lab 1: Environment Setup & Making Map
3	9-Sep 11-Sep	T Th	Spatial Autocorrelation / Spatial Relationship	Lab 2: Manipulating Geospatial Dat with Shapely and GeoPandas

4	16-Sep 18-Sep	T Th	Spatial Regression / GWR	Lab 3: Geospatial Data Collection
5	23-Sep 25-Sep	T Th	Spatial Clustering	Lab 4: Spatial Regression Analysis
6	30-Sep 2-Oct	T Th	Remote Sensing	Lab 5: Spatial Clustering Analysis
7	7-Oct 9-Oct	T Th	Network Analysis / Accessibility	Lab 6: Remote Sensing Analysis wit Leafmap
8	14-Oct 16-Oct	T Th	Machine Learning and GeoAI	Lab 7: Spatial Network Analysis
9	21-Oct 23-Oct	T Th	Ethics of GeoAI	Lab 8: Street View Imagery
10	28-Oct 30-Oct	T Th	Maps and Geovisualization	Lab 9: Big (Geo-)Data Visualizatior
11	4-Nov 6-Nov	T Th	Generative AI	Lab 10: Generative AI for Geospatia Analysis
12	11-Nov 13-Nov	T Th	Project preparation	Project preparation
13	18-Nov 20-Nov	T Th	Final Exam	Project preparation
14	25-Nov 27-Nov	T Th	Fall Break	
15	2-Dec 4-Dec	T Th	Project Presentations Project Presentations**	
* Final project proposal due: Nov. 9, 2025				
** Final project due: Dec. 8, 2025				