DSBA 6010 / GEOG 6030: Geospatial Data Analytics

Spring 2023

Lecture TU 5:30-8:15pm

CITY 501

Instructor: Jean-Claude Thill

Email: jfthill@uncc.edu

Office: McEniry 432

Office Hours: Thursday 1-2pm; or by appointment. I can meet @Dubois Center before class. On-line meetings are also possible (email to setup an appointment ahead of time)

Teaching assistant: Faizeh Hatami

Email: fhatami@uncc.edu

Office: McEniry 411A

Office hours: Wednesday 2-3pm; or by appointment. Faizeh can meet in person (main campus or Dubois Center on Tuesday afternoons) or on-line.

Welcome to Geospatial Data Analytics

The course has been designed to provide graduate students with the knowledge and skills that they need to understand how to handle geospatial data, process them, manipulate them, while focusing on their spatial properties to solve problems with a geospatial dimension. You will discover what is behind so-called "geographic information systems" and learn how to store, manage, retrieve, and analyze spatial data using R scripting. This syllabus is a contractual agreement between the students and professor and contains the policies and expectations established for this course. Please read the entire syllabus carefully before continuing in this course. All information on this syllabus are intended to create a productive learning environment.

Please note: This syllabus is subject to minor changes/adjustments throughout the semester. Students will be informed of any adjustments made by the instructor. Current information will always be available through the course website on Canvas. In case of inclement weather when the University closes or if class needs to be cancelled due to instructor illness, students will find information concerning assignments on Canvas. Students are advised to check Canvas frequently for up to date information.

General Course Information

Course Prerequisite

None, but you must have a working knowledge of R.

Course Description

Introduction to the nature of geospatial data and their use in data science. Topics include: Nature of spatial data, scale, representation, projection, topological relationships, data acquisition (geocoding, GPS, Volunteered Geographic Information), data uncertainty and accuracy, data organization and data modeling, imputation, spatial data manipulation and protection (geomasking, aggregation), overlay operations, network analysis, spatial autocorrelation (global and local), hot spot detection, spatial interpolation, spatial and space-time clustering. Notions of geovisualization and mapping are introduced throughout the class. Hands-on practice using R scripting.

Course Objectives

By the end of this course students will be able to:

- Understand the fundamentals of geospatial processing and the uses of various geospatial processing tools
- Gather appropriate and high quality data to solve spatial problems
- Process, manipulate, and visualize geospatial data, from start to finish
- Select and apply appropriate geospatial analysis tools to solve specific spatial problems

Course Webpage

You can access course materials on Canvas: http://canvas.uncc.edu/ . Please make sure you have access to Canvas and that you receive announcements and notifications during the first week of the class. Course lectures, exercises, assignments, grades, and announcements will all be posted on Canvas through the semester.

Course Materials

Required textbook

None.

Recommended textbooks

Gimond, Manuel. 2022. Intro to GIS and Spatial Analysis, https://mgimond.github.io/Spatial/index.html.

Lansley, G., and J. Cheshire. 2016. An Introduction to Spatial Data Analysis and Visualization in R, https://www.spatialanalysisonline.com/An%20Introduction%20to%20Spatial%20Data

%20Analysis%20in%20R.pdf.

Roger S. Bivand, Edzer Pebesma, and Virgilio Gomez-Rubio. 2013. Applied Spatial Data Analysis with R, Second Edition. New York: Springer.

Brunsdon, C., and L. Comber, L. 2018. An Introduction to R for Spatial Analysis and Mapping. SAGE Publications Ltd, London, UK.

Burrough, Peter A., and Rachael A. McDonnell. 2015. Principles of Geographical Information Systems, 3rd ed., Oxford University Press, Oxford, UK.

Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2015. Geographic Information Systems and Science , 4th ed., John Wiley and Sons, Toronto.

DeMers, Michael N. 2008. Fundamentals of Geographic Information Systems, 4th. ed., John Wiley and Sons, Toronto.

de Smith, Michael J., Michael F. Goodchild, and Paul A. Longley. 2018. Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools, 6th ed., The Winchelsea Press.

Bolstad, Paul. 2016. GIS Fundamentals, A First Text on Geographic Information Systems, 5th ed., Eider Press, White Bear Lake, Minnesota.

Chang, Kang-tsung. 2018. Introduction to Geographic Information Systems, 9th ed., McGraw-Hill Higher Education, Toronto.

Harvey, F. 2016. A Primer of GIS: Fundamental Geographic and Cartographic Concepts Second Edition, Guilford Press, New York.

PowerPoint slides

I will use PowerPoint slides for most of the lectures. I strongly suggest taking notes. PowerPoint slides will be posted on Canvas right before class.

Software

Various libraries of R scripting.

Wi-Fi Enabled Device

You must have a Wi-Fi enabled laptop and bring it to class. This will help you follow the lectures and take notes. Also, tutorials and exercises will be conducted in class.

Course Assignments/Assessments

In-class exercises (10 points in total) and homework assignments (40 points in total)

The course includes in-class exercises and homework assignments. Data and instructions will be available on Canvas. Homework assignments will need to be completed on your own time and individually. Homework answers will need to be turned in on Canvas one week later.

Final exam

The questions are from the slides, lectures that I give during sessions. The final exam will be based on material presented after the mid-term exam. The experience shows those who take notes during the class get the best results in exams.

Final project (100 points)

Each student is responsible for turning in a final project that applies concepts/tools that you learned through the semester. The purpose of the project is to gain exposure to geospatial analytical research and application. You will produce your own research questions, source your own data, conduct geospatial analysis in R, and produce high quality maps/graphs to communicate your results. Students will work individually. The tasks for the final project are as follows:

- A 1-page proposal (double-spaced) describing the idea of your final project (due: 2/23/2023). (5 points)
- Source your data by this date to facilitate your progress (due date: 2/23/2023). (5 points)
- A 5-minute progress report meeting with me and TA about your project (between week of 3/20-3/25). (5 points)
- A 7-minute, 4-5 slides, PowerPoint presentation describing your project topic background, method, results, conclusion and future work (date: 5/9/2023). (25 points)
- A final paper, 4-5 pages long (double-spaced, 12-pt font) EXCLUDING maps, graphs and tables, bibliography, must contain each of the following sections: (1) an introduction, (2) statement of purpose/objective(s), (3) methods, (4) results, (5) conclusions (due date: 5/8/2023) (60 points)

Please Notice: A detailed rubric for all steps above is accessible on Canvas. Students are expected to read the rubrics to be aware of the criteria I have for grading the project.

Grading

Task	Grade points
Midterm exam	50 points total
Final exam	50 points total
In-class assignments	10 points total
Homework assignments	40 points total
Final project	100 points total
Total	250 points

Scale: A: 225-250, B: 200-224, C: 175-199, D: 150-174, F<174

Course Policies

Attendance

Students are expected to attend every class. I do not include everything in slides, so you may not be able to answer all exam questions only by going over slides (a good reason to avoid missing a class). If you are absent please be responsible to obtain notes from your classmates. Please be respectful of other classmates and arrive and leave the class on time.

Communication Statement

I usually answer emails as soon as I can, but leave one day to hear back from me. TA office is McEniry 411A on the main campus. Please contact Faizeh to schedule a meeting in McEniry or in the Center City building. Zoom meetings with me as well as with Faizeh are possible. Please plan ahead of time for this.

Late Assignment Policy

Late assignments will be penalized as follows:

- Up to one day late (24h): -25%
- 2 day late: -50%
- More than 2 days late: No longer accepted

Please try to plan ahead if you have another commitment. In the case of a medical condition, please provide proof from a doctor or clinic. I will ignore **only** the first time that you submit your assignment late.

Class behavior

(1) Please turn off and put away your cell phone before entering the classroom.

(2) Do not use the computers during lectures to browse the internet, check your social media account, watch sports, do homework for other classes, or play games. After an initial warning, you will be asked to leave the classroom. It is very distracting for everyone.

(3) In case you are waiting for an emergency call, reach out to me before the class and we will handle the situation
(4) Why do I have this policy? The assumption is you are coming to class to learn new materials. Paying attention is the first requirement of learning. Studies show that using of cellphones (even if it is on the desk) or other electronic devices open space for distraction. Since we use the cellphones a lot, sometimes it is just habitual to use them. Refrain from using your phone at all during class time.

University Policies

Ethics

If you are contemplating an ethical failure please read the code of student academic integrity: http://www.legal.uncc.edu/policies/ps-105.html, so you can plan for the consequences. Students are encouraged to work on their own, but helping each other understand concepts is fine. In other words, you may work with other students on lab assignments but you may not copy projects or written answers to questions from another student. Examples of unacceptable actions that will warrant a phone call to the dean of student's office:

- Turning in assignments with answers to written questions that are identical to another student in the class. All words and thoughts should be your own
- Turning in assignments from students from past semesters

Withdrawals

Students are expected to complete all courses for which they are registered at the close of the add/drop period. If students are concerned about succeeding in the course, it is important to make an appointment to speak with the course instructor as soon as possible. The University policy on withdrawal allows students only a limited number of opportunities available to withdraw from courses. It is important for students to understand the financial and academic consequences that may result from course withdrawals. The UNC Charlotte Academy Policy on Withdrawals for Undergraduate students is available from the Office of the Provost or online at:

http://provost.uncc.edu/policies/withdrawal

Students with disabilities

Students in this course seeking accommodations to disabilities must first consult with the Office of Disabilities Services (http://www.ds.uncc.edu or 704-687-0040) and follow the instructions of that office for obtaining accommodations.

Religious Accommodations Policy

UNC Charlotte provides reasonable accommodations, including a minimum of two excused absences each academic year, for religious observances required by a student's religious practice or belief. Such reasonable accommodations must be requested in accordance with the procedures in this Policy, and include the opportunity for the student to make up any tests or other work missed due to an excused absence for a religious observance. Students wishing to request a religious accommodation may refer to the information found at http://legal.uncc.edu/policies/ps-134.html.

Online Student Course Evaluation Process and Confidentiality

Courses are evaluated through an online evaluation survey process. Student course evaluations provide an important source of feedback for faculty regarding course design and instructional effectiveness. The online course evaluations are administered at the end of the term, during the final two week (prior to final exams). You will receive an email announcement alerting you when the survey period opens. Periodic reminders will be sent during the time the survey is open. Please be advised that this process is secure and confidential. The technology used ensures anonymity of participants as well as confidentiality. The School of Data Science is committed to excellent instruction and student support. Please help in continuing this commitment by participating in the course evaluation process.

Tentative course schedule (subject to updates)

Week	Date	Lecture	Notice
1	1/10/2023	Course Outline Intro to GIS/geospatial data analytics Fundamentals of GIS (1)	
2	1/17/2023	Fundamentals of GIS (2) R tutorial	
3	1/24/2023	Datum and coordinate systems Map projections	
4	1/31/2023	Symbolizing features Mapping and geovisualization	
5	2/7/2023	Vector data model Vector data manipulation	
6	2/14/2023	Understanding spatial queries Topology and topological relationships	
7	**2/21/2023**	**Mid-term exam** Data uncertainty and accuracy	
8	**2/28/2023**	**Student Recess - No classes**	
9	3/7/2023	Spatial data collection-Global Positioning Systems (GPS)	
10	3/14/2023	Spatial analysis of vector data	
11	**3/21/2023**	**One-on-one meetings re. project** Geocoding and georeferencing	
12	3/28/2023	Catch-up or cancelled class	
13	4/4/2023	Network analysis	
14	4/11/2023	Spatial interpolation & point patterns	
15	4/18/2023	Hot spot detection Spatial and space-time clustering	
16	4/25/2023	Spatial Autocorrelation	
17	**5/2/2023**	**FINAL EXAM**	
	5/9/2023	**Project Presentations @ 5-7pm**	