

GEOG 5550 – Advanced GIS

Spring 2022

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Office hours: ENV 372, Mon 5 - 6 pm, or by appointment.

Prerequisites

GEOG 3500/5510, or consent of department.

Objectives

This course aims to improve students' spatial thinking skills through advanced GIS topics in spatial analysis, three-dimensional (3D) analysis, and network analysis. The course includes a combination of lectures, hands-on exercises, homework, short essays, and an individual project. Upon successful completion of the course, students should be able to: (1) conduct visualization, conversion, and analysis of categorical and continuous raster data; (2) manipulate raster data through local, focal, and zonal statistics; (3) use spatial interpolation, surface analysis, and hydrologic modeling tools; (4) apply spatial analysis, 3D analysis, and network analysis methods to solve real-world problems; and (5) design a GIS project. Students are required to participate in group or individual meetings with the instructor to discuss advanced GIS topics.

References

- (1) ArcGIS Extensions: <https://desktop.arcgis.com/en/arcmap/10.7/extensions/main/about-arcgis-for-desktop-extensions.htm> (Spatial Analyst, ArcScan, 3D Analyst, and Network Analyst)
- (2) Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley, *Geospatial Analysis*, 6th Edition, 2021 update. (Free web version: <https://spatialanalysisonline.com/HTML/index.html>).

Software

ArcGIS Desktop 10.7.1 with Spatial Analyst, ArcScan, 3D Analyst, and Network Analyst extensions. You can [access UNT CSAM1 and CSAM2 labs remotely](#). If you like to install ArcGIS 10.7.1 on your personal computer, please contact the instructor for a software code.

Labs and Homework

Labs and homework should be submitted to Canvas. Late submissions will be marked down 10% each day.

Essays

Students will complete two short essays (1 single-spaced page) assigned by the instructor. Each graduate student is also required to write a third essay (2 single-spaced pages) on new developments in GIS. The topic can be related to the hardware, software, methods, data products, or emerging applications of GIS. Please discuss your topic with the instructor.

Quizzes

The course has three quizzes in Canvas. Each quiz has 10 questions (True/False and multiple choice).

Course Project

Each student will design and implement a course project involving raster data analysis. A project report of at least five single-spaced pages (NOT including tables, figures, and references) will be graded. More instructions on the project will be provided in class.

Grading Structure

Labs (35 labs) and group meetings	25%
Two short essays (1 single-spaced page)	10%
One essay on new developments in GIS (2 single-spaced pages)	10%
Three homework assignments	15%
Three quizzes (each quiz has 10 questions)	15%
Project report	25%
Total	100%
90-100: A; 80-89: B; 70-79: C; 60-69: D; 0-59: F. A minimum grade of "B" is required for the GIS Certificate.	

Schedule

Week	Date	Topic	Assignment
2	1/24	1. Review of GIS Basics 1.1 Review of basic GIS concepts 1.2 Vector data model 1.3 Feature selection 1.4 Attribute tables 1.5 Clip, intersect, union, and buffer 1.6 Merge, dissolve, and spatial join 1.7 Feature editing 1.8 Projection	Lab 1.1 Selecting features (1 point) Lab 1.2 Working with tables (1 point) Lab 1.3 Creating points and lines (1 point) Lab 1.4 Creating polygons (1 point)
3	1/31	2. ModelBuilder 2.1 Executing tools in ModelBuilder 2.2 Creating tools with ModelBuilder	Lab 2.1 ModelBuilder (1) (1 point) Lab 2.2 ModelBuilder (2) (1 point)
4	2/7	3. Basics of Raster Data 3.1 Raster data model 3.2 Categorical rasters 3.3 Continuous rasters 3.4 Digital images 3.5 Displaying raster values 3.6 Raster formats 3.7 Raster naming conventions 3.8 Raster vs. vector	Lab 3.1 NLCD data (1 point) Lab 3.2 Continuous rasters (1) (1 point) Lab 3.3 Continuous rasters (2) (1 point) Lab 3.4 Digital images (1 point)
5	2/14	4. Raster Conversion and Extraction 4.1 Environment settings 4.2 Vector to raster conversion 4.3 Raster to vector conversion 4.4 Raster to ASCII conversion 4.5 Raster layer to KML conversion 4.6 Raster to raster conversion 4.7 Raster to video conversion 4.8 Raster extraction by attributes 4.9 Raster extraction by mask 4.10 Extracting raster values to points	Lab 4.1 Vector to raster (1 point) Lab 4.2 Raster layer to KML (1 point) Lab 4.3 Raster extraction (1) (1 point) Lab 4.4 Raster extraction (2) (1 point)

6	2/21	5. Local Analysis 5.1 Frequency 5.2 Highest position 5.3 Lowest position 5.4 Cell statistics	Lab 5.1 Cell statistics (1 point) Lab 5.2 Local analysis (1 point) Quiz 1 (5 points) Homework 1 (due 3/21)
7	2/28	6. Focal Analysis 6.1 Definition of focal analysis 6.2 Shape and size of neighborhood 6.3 Focal statistics 6.4 Point statistics 6.5 Line statistics	Lab 6.1 Focal statistics (1 point) Lab 6.2 Point statistics (1 point) Short Essay 1 (5 points, due 4/18)
8	3/7	7. Zonal Analysis 7.1 Definition of a zone 7.2 Zonal statistics 7.3 Zonal statistics as table 7.4 Zonal geometry 7.5 Zonal histogram	Lab 7.1 Zonal statistics (1) (1 point) Lab 7.2 Zonal statistics (2) (1 point)
9	3/14	Spring Break	
10	3/21	8. Map Algebra and Distance Transformation 8.1 Map algebra 8.2 Raster calculator 8.3 Euclidean distance 8.4 Euclidean allocation 8.5 Weighted Voronoi diagrams	Lab 8.1 Raster calculator (1) (1 point) Lab 8.2 Raster calculator (2) (1 point) Lab 8.3 Distance/allocation rasters (1 point) Lab 8.4 Weighted Voronoi diagrams (1 point) Quiz 2 (5 points) Homework 2 (due 4/18)
11	3/28	9. ArcScan 9.1 Interactive vectorization 9.2 Automatic vectorization	Lab 9.1 Interactive vectorization (1 point) Lab 9.2 Automatic vectorization (1 point)
12	4/4	10. Spatial Interpolation 10.1 Definition of spatial interpolation 10.2 Inverse distance weighed interpolation 10.3 Natural neighbor 10.4 Spline 10.5 Trend surface	Lab 10.1 Spatial interpolation (1 point) Lab 10.2 Trend surface analysis (1 point)
13	4/11	11. Hydrologic Modeling 11.1 Digital elevation models (DEM) 11.2 Flow direction 11.3 Flow accumulation 11.4 Flow length and flow distance 11.5 Sink and fill 11.6 Basin 11.7 Watershed	Lab 11.1 Hydrologic modeling (1 point)
14	4/18	12. Surface and 3D Analysis 12.1 Surface models 12.2 Slope and aspect 12.3 Cut Fill 12.4 Hillshade 12.5 Viewshed 12.6 Line of sight 12.7 Stack profile 12.8 ArcScene	Lab 12.1 Surface analysis and 3D analysis (1) (1 point) Lab 12.2 Surface analysis and 3D analysis (2) (1 point) Homework 3 (due 5/9) Short Essay 2 (5 points, due 5/9)
15	4/25	13. Network Analysis 13.1 Network dataset 13.2 Closest facility 13.3 Vehicle routing 13.4 Service area	Lab 13.1 Creating a network dataset (1 point) Lab 13.2 Finding the best route (1 point) Lab 13.3 Finding the closest facility (1 point) Lab 13.4 Calculating service area (1 point) Quiz 3 (5 points)
16	5/2	Project Week	
17	5/9	Final Week	3rd Essay and project report due on 5/12

Extra Credit

The Department of Geography does not allow extra credit assignments (work not specified on a course syllabus).

Academic Dishonesty

Students caught cheating or plagiarizing will receive a "0" for that particular assignment or exam. Additionally, the incident will be reported to the Office of Student Rights and Responsibilities for further penalty. According to the UNT catalog, the term "cheating" includes, but is not limited to:

- a. Use of any unauthorized assistance in taking quizzes, tests, or examinations;
- b. Dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments;
- c. The acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university;
- d. Dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s); or
- e. Any other act designed to give a student an unfair advantage.

The term "plagiarism" includes, but is not limited to:

- a. The knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment; and
- b. The knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.

Face Coverings

UNT encourages everyone to wear a face covering when indoors, regardless of vaccination status, to protect yourself and others from COVID infection, as recommended by current CDC guidelines. Face covering guidelines could change based on community health conditions.

Course Materials for Remote Instruction

Remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to a webcam and microphone to participate in fully remote portions of the class. Information on how to be successful in a remote learning environment can be found at <https://online.unt.edu/learn>

Class Attendance

Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the professor and the instructional team prior to being absent, so you, the professor, and the instructional team can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community.

If you are experiencing any symptoms of COVID-19 (<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.

Rules of Engagement

Rules of engagement refer to the way students are expected to interact with each other and with their instructors. Here are some general guidelines:

- While the freedom to express yourself is a fundamental human right, any communication that utilizes cruel and derogatory language on the basis of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law will not be tolerated.
- Treat your instructor and classmates with respect in any communication online or face-to-face, even when their opinion differs from your own.
- Ask for and use the correct name and pronouns for your instructor and classmates.
- Speak from personal experiences. Use “I” statements to share thoughts and feelings. Try not to speak on behalf of groups or other individual’s experiences.
- Use your critical thinking skills to challenge other people’s ideas, instead of attacking individuals.
- Avoid using all caps while communicating digitally. This may be interpreted as “YELLING!”
- Be cautious when using humor or sarcasm in emails or discussion posts as tone can be difficult to interpret digitally.
- Avoid using “text-talk” unless explicitly permitted by your instructor.
- Proofread and fact-check your sources.
- Keep in mind that online posts can be permanent, so think first before you type.

See these [Engagement Guidelines](https://clear.unt.edu/online-communication-tips) (https://clear.unt.edu/online-communication-tips) for more information.

Accommodations

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the Office of Disability Accommodation website at <http://www.unt.edu/oda>. You may also contact them by phone at 940.565.4323.

Classroom Courtesy

Please follow these guidelines to avoid disrupting the class:

- (1) Turn off cell phones before arriving.
- (2) Do not arrive late or leave early (except for a bathroom break or emergency).
- (3) Do not sleep or eat during class.
- (4) Do not work on other assignments during class.
- (5) Do not talk when the instructor is lecturing, unless prompted for feedback by the instructor.

Course Evaluation

You will receive an email with a link to the UNT Student Perceptions of Teaching (SPOT) Course Evaluation by the end of the semester.
