

# **GEOG 5550 – Advanced GIS (online, asynchronous)**

Summer 2022, 5W2, July 11 – August 12, 2022

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Virtual Office Hours: Tuesdays & Wednesdays 1:00 – 2:00 pm.



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## **Prerequisites**

GEOG 3500/5510, or consent of department.

## **Objectives**

This online asynchronous 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, online quizzes, 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; (5) identify some new developments in GIS; and (6) design and implement 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](#) (Spatial Analyst, ArcScan, 3D Analyst, and Network Analyst)
- (2) Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley, [Geospatial Analysis](#), 6<sup>th</sup> Edition, 2020 update. (Free web version).

## **Software**

ArcGIS Desktop 10.x or ArcGIS Pro 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.x or ArcGIS Pro on your personal computer, please contact the instructor for a license file.

## **Labs and Homework**

Labs and homework should be submitted to Canvas. Each lab should be finished within two days, and the instructor will check the labs every two days. Late labs and homework will be marked down 10% each day.

## **Short Essays**

Graduate 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.

## **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 5 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	35%
Three short essays (1 single-spaced page)	15%
Three homework assignments	15%
Three quizzes (each quiz has 10 questions)	15%
Project report	20%
<b>Total</b>	<b>100%</b>
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

Date	Topics	Assignments
July 11	<b>1. Review of GIS Basics</b> 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)
July 12	<b>2. ModelBuilder</b> 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)
July 13	<b>3. Basics of Raster Data</b> 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)
July 14	<b>4. Raster Conversion and Extraction</b> 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	Lab 4.1 Vector to raster (1 point) Lab 4.2 Raster layer to KML (1 point)
July 18	4.8 Raster extraction by attributes 4.9 Raster extraction by mask 4.10 Extracting raster values to points	Lab 4.3 Raster extraction (1) (1 point) Lab 4.4 Raster extraction (2) (1 point)
July 19	<b>5. Local Analysis</b> 5.1 Frequency 5.2 Highest position 5.3 Lowest position	Lab 5.1 Cell statistics (1 point) Lab 5.2 Local analysis (1 point) <b>Quiz 1 (5 points)</b> <b>Homework 1 (due 7/24)</b>

	5.4 Cell statistics	
July 20	<b>6. Focal Analysis</b> 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) <b>Short Essay 1 (5 points, due 7/27)</b>
July 21	<b>7. Zonal Analysis</b> 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)
July 25	<b>8. Map Algebra and Distance Transformation</b> 8.1 Map algebra 8.2 Raster calculator	Lab 8.1 Raster calculator (1) (1 point) Lab 8.2 Raster calculator (2) (1 point)
July 26	8.3 Euclidean distance 8.4 Euclidean allocation 8.5 Weighted Voronoi diagrams	<b>Quiz 2 (5 points)</b> Lab 8.3 Distance/allocation rasters (1 point) Lab 8.4 Weighted Voronoi diagrams (1 point) <b>Homework 2 (due 8/1)</b>
July 27	<b>9. ArcScan</b> 9.1 Interactive vectorization 9.2 Automatic vectorization	Lab 9.1 Interactive vectorization (1 point) Lab 9.2 Automatic vectorization (1 point)
July 28	<b>10. Spatial Interpolation</b> 10.1 Definition of spatial interpolation 10.2 Inverse distance weighed interpolation 10.3 Natural neighbor	Lab 10.1 Spatial interpolation (1 point)
Aug 1	10.4 Spline 10.5 Trend surface	Lab 10.2 Trend surface analysis (1 point)
Aug 2	<b>11. Hydrologic Modeling</b> 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)
Aug 3	<b>12. Surface and 3D Analysis</b> 12.1 Surface models 12.2 Slope and aspect 12.3 Cut Fill 12.4 Hillshade	Lab 12.1 Surface analysis and 3D analysis (1) (1 point) <b>Homework 3 (due 8/8)</b> <b>Short Essay 2 (5 points, due 8/8)</b> <b>Short Essay 3 (5 points, due 8/11)</b>
Aug 4	12.5 Viewshed 12.6 Line of sight 12.7 Stack profile 12.8 ArcScene	Lab 12.2 Surface analysis and 3D analysis (2) (1 point)
Aug 8	<b>13. Network Analysis</b> 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)
Aug 9	Course Project	<b>Quiz 3 (5 points)</b>
Aug 10	Course Project	
Aug 11	Course Project	<b>Short Essay 3 Due</b>
Aug 12	Course Project	<b>Project Report Due</b>

## **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.

## **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.