

# **GEOG 4550 – Advanced GIS (online)**

Summer 2020, 5W2, July 6 – August 7, 2020

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## **Prerequisites**

GEOG 3500: Introduction to GIS (or consent of department)

## **Objectives**

This course is built on GEOG 3500 "Introduction to GIS". Some advanced GIS topics in spatial analysis, three-dimensional (3D) analysis, and network analysis will be introduced through 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; and (4) apply spatial analysis, 3D analysis, and network analysis methods to solve real-world problems.

## **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*, 6<sup>th</sup> Edition, 2020 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.

## **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**

Students will complete **two** short essays (1 single-spaced page) assigned by the instructor.

## **Course Project**

Each student will design and implement a course project involving raster data analysis. A project report of 3-4 single-spaced pages (NOT including tables, figures, and references) will be graded. More instructions on the project will be provided in class.

## Quizzes

The course has three quizzes. Each quiz has 10 questions (True/False, multiple choice, and short answer questions).

## Grading Structure

|   |             |
|---|-------------|
| Labs (35 labs)  | 25%         |
| Two short essays (1 single-spaced page; 5% each)  | 10%         |
| Three homework assignments (10% each)   | 30%         |
| Three quizzes (each quiz has 10 questions, 5% each)   | 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 6  | <b>1. Review of GIS Basics</b><br>1.1 Review of basic GIS concepts<br>1.2 Vector data model<br>1.3 Feature selection<br>1.4 Attribute tables<br>1.5 Clip, intersect, union, and buffer<br>1.6 Merge, dissolve, and spatial join<br>1.7 Feature editing<br>1.8 Projection                  | Lab 1.1 Selecting features (0.5 point)<br>Lab 1.2 Working with tables (0.5 point)<br>Lab 1.3 Creating points and lines (0.5 point)<br>Lab 1.4 Creating polygons (0.5 point) |
| July 7  | <b>2. ModelBuilder</b><br>2.1 Executing tools in ModelBuilder<br>2.2 Creating tools with ModelBuilder   | Lab 2.1 ModelBuilder (1) (1 point)<br>Lab 2.2 ModelBuilder (2) (1 point)  |
| July 8  | <b>3. Basics of Raster Data</b><br>3.1 Raster data model<br>3.2 Categorical rasters<br>3.3 Continuous rasters<br>3.4 Digital images<br>3.5 Displaying raster values<br>3.6 Raster formats<br>3.7 Raster naming conventions<br>3.8 Raster vs. vector                                       | Lab 3.1 NLCD data (0.5 point)<br>Lab 3.2 Continuous rasters (1) (0.5 point)<br>Lab 3.3 Continuous rasters (2) (0.5 point)<br>Lab 3.4 Digital images (0.5 point)             |
| July 9  | <b>4. Raster Conversion and Extraction</b><br>4.1 Environment settings<br>4.2 Vector to raster conversion<br>4.3 Raster to vector conversion<br>4.4 Raster to ASCII conversion<br>4.5 Raster layer to KML conversion<br>4.6 Raster to raster conversion<br>4.7 Raster to video conversion | Lab 4.1 Vector to raster (0.5 point)<br>Lab 4.2 Raster layer to KML (0.5 point)   |
| July 13 | 4.8 Raster extraction by attributes<br>4.9 Raster extraction by mask<br>4.10 Extracting raster values to points   | Lab 4.3 Raster extraction (1) (0.5 point)<br>Lab 4.4 Raster extraction (2) (0.5 point)  |
| July 14 | <b>5. Local Analysis</b><br>5.1 Frequency<br>5.2 Highest position<br>5.3 Lowest position<br>5.4 Cell statistics   | Lab 5.1 Cell statistics (1 point)<br>Lab 5.2 Local analysis (1 point)<br><b>Quiz 1 (5 points)</b><br><b>Homework 1 (due 7/21)</b>   |

|         |  |  |
|---------|--|--|
| July 15 | <b>6. Focal Analysis</b><br>6.1 Definition of focal analysis<br>6.2 Shape and size of neighborhood<br>6.3 Focal statistics<br>6.4 Point statistics<br>6.5 Line statistics  | Lab 6.1 Focal statistics (1 point)<br>Lab 6.2 Point statistics (1 point)<br><b>Short Essay 1 (5 points)</b>  |
| July 16 | <b>7. Zonal Analysis</b><br>7.1 Definition of a zone<br>7.2 Zonal statistics<br>7.3 Zonal statistics as table<br>7.4 Zonal geometry<br>7.5 Zonal histogram   | Lab 7.1 Zonal statistics (1) (1 point)<br>Lab 7.2 Zonal statistics (2) (1 point)   |
| July 20 | <b>8. Map Algebra and Distance Transformation</b><br>8.1 Map algebra<br>8.2 Raster calculator  | Lab 8.1 Raster calculator (1) (0.5 point)<br>Lab 8.2 Raster calculator (2) (0.5 point)   |
| July 21 | 8.3 Euclidean distance<br>8.4 Euclidean allocation<br>8.5 Weighted Voronoi diagrams  | <b>Quiz 2 (5 points)</b><br>Lab 8.3 Distance/allocation rasters (0.5 point)<br>Lab 8.4 Weighted Voronoi diagrams (0.5 point)<br><b>Homework 2 (due 7/29)</b>   |
| July 22 | <b>9. ArcScan</b><br>9.1 Interactive vectorization<br>9.2 Automatic vectorization  | Lab 9.1 Interactive vectorization (1 point)<br>Lab 9.2 Automatic vectorization (1 point)   |
| July 23 | <b>10. Spatial Interpolation</b><br>10.1 Definition of spatial interpolation<br>10.2 Inverse distance weighed interpolation<br>10.3 Natural neighbor   | Lab 10.1 Spatial interpolation (1 point)   |
| July 27 | 10.4 Spline<br>10.5 Trend surface  | Lab 10.2 Trend surface analysis (1 point)  |
| July 28 | <b>11. Hydrological Modeling</b><br>11.1 Digital elevation models (DEM)<br>11.2 Flow direction<br>11.3 Flow accumulation<br>11.4 Flow length and flow distance<br>11.5 Sink and fill<br>11.6 Basin<br>11.7 Watershed | Lab 11.1 Hydrologic modeling (1 point)   |
| July 29 | <b>12. Surface and 3D Analysis</b><br>12.1 Surface models<br>12.2 Slope and aspect<br>12.3 Cut Fill<br>12.4 Hillshade  | Lab 12.1 Surface analysis and 3D analysis (1) (1 point)<br><b>Homework 3 (due 8/7)</b><br><b>Short Essay 2 (5 points)</b>  |
| July 30 | 12.5 Viewshed<br>12.6 Line of sight<br>12.7 Stack profile<br>12.8 ArcScene   | Lab 12.2 Surface analysis and 3D analysis (2) (1 point)  |
| Aug 3   | <b>13. Network Analysis</b><br>13.1 Network dataset<br>13.2 Closest facility<br>13.3 Vehicle routing<br>13.4 Service area  | Lab 13.1 Creating a network dataset (0.5 point)<br>Lab 13.2 Finding the best route (0.5 point)<br>Lab 13.3 Finding the closest facility (0.5 point)<br>Lab 13.4 Calculating service area (0.5 point) |
| Aug 4   | Course Project   | <b>Quiz 3 (5 points)</b>   |
| Aug 5   | Course Project   |  |
| Aug 6   | Course Project   |  |
| Aug 7   | Course Project   | Projects Due   |

## **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.