GEOS 205: Introduction to GIS

MWF 12:30-1:30; Tues 8:30-11:20
JSC 222 & 201 (Geoscience Mac Lab)
Office Hours: use link to calendar on Moodle

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What is GIS?

GIS stands for Geographic Information System, a generic term for any software application that links information to place and is capable of viewing, overlaying, and manipulating geographic data. A GIS is much more than a simple mapping program. Most GIS packages (including the one we will be using) enable the user to perform complex transformations and spatial/statistical analyses upon spatial data, and to visualize these data in a variety of informative ways. GIS has applications in all branches of Earth and space science, biology, industry, government, business, engineering, and any endeavors for which analyses of spatial data are required.

A GIS is an organizational structure for creating scaled models of the real world. Any system that stores lists of data and relates those data to objects with coordinates in space can be considered a GIS. The real power of modern GIS systems, however, lies in the ability to manipulate and interrogate spatial data based both on the geometry of objects and the information that is stored about them, and to model natural and social phenomena to make predictions.

ArcGIS software

Although there are many GIS packages available, the most widely used (and by far the most comprehensive) software package is ESRI ArcGIS. This is what we will be using for this class. The learning curve of ArcGIS is very steep, but because it is the industry standard for the foreseeable future, experience using this software is very valuable in today's job market. Understanding how the software works is even more valuable, and that is the point of this class.

ArcGIS doesn't always react in the way you might expect, because it always does *exactly* what you tell it to. Figuring out how to translate what you want into what the computer will understand usually takes time. Expect everything you do using ArcGIS to take up to 1000 times longer than you think it will. This figure multiplies exponentially the nearer you get to a deadline according to the equation:

$$\text{Actual time spent} = [1000 \times \text{Time you thought}]^{1/\text{days before deadline}}$$

The point is: *work slowly, carefully, and thoughtfully, and leave yourself plenty of time to complete assignments!*

Goals of this course

The primary goal of this course is not to teach you how to use the software. That undertaking would not only be pointless (because software updates occur so regularly that this information would soon be out-of-date), but also futile: ArcGIS is simply too big to teach in its entirety over the course of one semester. Instead, the purpose of this class is to teach you the basic concepts and language of GIS so that you can adapt yourself to *any* GIS system and understand what you are doing. Along the way, you will gain some familiarity with ArcGIS Pro as a bonus.

Students will be able to:

1. Create geographic data and import it into a GIS;
2. Transform raster and vector data between coordinate systems;
3. Use common methods of spatial analysis to solve problems;
4. Create visually pleasing and informative maps.

Course outline

This course consists of three main components: 1) lecture/discussion (theory); 2) laboratory assignments and homework (practice); and 3) a portfolio of your work (product). Each week we will examine a new topic (see schedule for details). Assessment of your mastery of the material will consist of several quizzes and two take-home exams.

Lecture/discussion- GIS theory

The lecture/discussion component of this course is geared to introduce you to concepts that we will explore in the lab exercises. I will use a combination of PowerPoint presentations, demonstrations, and examples to teach you underlying concepts and the procedures for implementing them in ArcGIS. We will also work through example problems during this time. You will be quizzed weekly (ideally every Friday) on this material.

Lab exercises and homework- GIS practice

The lab exercises and homework in this course are designed to give you "hands-on" experience using the ArcGIS software (along with all of its quirks and pitfalls), while developing mastery of a particular concept. **Attendance in lab is mandatory.** Homework will be assigned as needed to supplement concepts presented in the lecture. Unless otherwise noted, each lab assignment will be assigned on Tuesday and due the following Tuesday. Please work on labs and homework individually so that you are clear about what you are doing, because you will be tested on it!

Completed lab exercises will be evaluated on the basis of 1) quality of presentation, 2) completeness; and 3) correctness. Pay close attention to handing in a formal, polished product. This may take some time! Many of these lab assignments, if presented nicely, could someday be useful for demonstrating your GIS skill to potential employers, which is the point of the:

Portfolio- GIS product

After receiving feedback from me about the quality of your lab work, you may choose to revise it prior to including it in a portfolio of your work, due at the end of the semester. This should present the best maps from both your lab assignments and exam analyses, all with brief explanations, in a compact format that is as professional as you can make it. The final week of classes, we will assemble your revised work into an online ESRI Story Map series that you can link to as a portfolio of your work.

Exams and quizzes

There will be short quizzes each week or so covering the topic for that week. These will be announced ahead of time. In addition, there will be two take-home exams, in which you will be required to solve several new problems using GIS. *Allow ample time for these.* Often, they can be quite time-consuming—particularly if you solve the problems presented to you in an indirect way. *You may not collaborate or in any way discuss the exams during the week they are assigned*, except to ask questions of me. Any attempt to do so will be considered academic dishonesty and dealt with using the procedures outlined in the Academic Handbook. Take-home exams will be given on a Monday and collected the following Monday.

There is no final exam for the course—your second take-home exam is due on the last day of finals.

Project/GIS Day poster

We may undertake a collaborative GIS project in this course. The City of Greencastle wants to develop a GIS of stormwater drainage systems near campus. This is a *real* project: the city will be using our data in their GIS for planning purposes, so we have to be careful and do things right. If the project works out this semester, then there is potential for future collaboration down the road! The collaborative project (if it happens) will be included in your participation grade.

You may also, for extra credit, create a poster (individually, or as a team) for display during the GIS Day Celebration in the Julian Atrium on Wednesday, November 15. Posters must be approved for display by me before credit will be given. If you have a project that you would like to undertake in GIS for display at this event, please talk to me. This could raise your grade in the class by up to half a grade point.

Course materials

The textbook for this course is:

Bolstad, P., *GIS Fundamentals, Seventh Edition.* Baker and Taylor, 2022.

Available in various formats for $18-$44 from gisfundamentals.org

This is the most useful, broadly applicable, and inexpensive reference text for a GIS class at this level. It is excellent. But it is also very long and boring.

In addition, the ArcGIS help file, available from the Help menu in ArcGIS and accessible from every dialog box or window in ArcGIS, is an excellent source of technical information. Use it! (RTFM)

ChatGPT knows a little about GIS, too! You can ask it specific questions if you're stuck on something.

STEM Guide:

We will have a STEM Guide (Quincie Simmons) helping us through the class this semester. Details of her participation will be announced in class later. If you find that you are particularly talented at GIS, you may find yourself in a similar position the next time this course is taught!

Assessment:

Your grade will be based upon the following criteria:

Exams:	40%
Participation, laboratory activities, homework:	30%
Quizzes:	20%
Story Map Portfolio:	10%

Attendance policy:

If you miss a class due to illness, etc., you are responsible for obtaining the notes, lab assignments, homework, etc. from someone else in the class.

Food and drink in the lab:

Food and drink make your fingers sticky. That makes keyboards, mice, and monitors sticky. They then become coated with a sticky goop. Leave food and drink out of the computer lab at all times. First offense is a warning. Second offense and you will find your food/drink in the trash. Eating while working isn't healthy, anyways. If this becomes a serious problem, we may need to limit access to the lab to normal daytime hours.

A note about data storage and management:

You will all be provided with disk space on the I: drive under which to store data for this course. It is important to be organized, to delete unnecessary files, and to save work frequently in order to avoid losing anything! "I lost my data" is the IT equivalent of "the dog ate my homework". It is not a valid excuse for handing in late work.

Technical Forum:

Please post problems (and solutions!) to the Technical Forum on Moodle. I will monitor this forum and respond as soon as I can to any requests for help.

GEOS 205 Schedule

Week of:	Topic	Lab activity (Tues)	Reading	Other
Aug 23	Introduction, map basics	----	Ch. 1	
Aug 28	GIS data models	Basic map creation	Ch. 2	
Sept 4	Coordinate Systems	Projections, measurement, & scale	Ch. 3	**Labor Day Holiday**
Sept 11	Data editing and transformation	Data editing and topology	Ch. 4	
Sept 18	GPS and GNSS	Georeferencing and GPS	Ch. 5	
Sept 25	Satellite and aerial imagery	Drone mapping and photogrammetry	Ch. 6	
Oct 2	Digital Data	LULC from LANDSAT	Ch. 7	**EXAM 1 (due Oct 9)**
Oct 9	Attributes and databases	Querying and classifying data	Ch. 8	
	FALL BREAK: OCT 14-22			
Oct 23	Vector analysis	Overlay mapping	Ch. 9	
Oct 30	Raster analysis	Raster functions	Ch. 10	
Nov 6	Terrain analysis	Hydrologic modeling	Ch. 11	
Nov 13	Interpolation	Interpolation methods	Ch. 12	**GIS Day**
Nov 20	Spatial analysis	Cluster analysis	Ch. 13	
	THANKSGIVING BREAK: November 22-26			
Nov 27	Mapping change	Mapping change	Ch. 14-15	**EXAM 2 (due Dec 11)**
Dec 4	Story Maps	Portfolio	---	

Exam 2 and portfolio due by Monday, Dec 11, 11:30 AM