Geology 3401 – Interdisciplinary Geographical Information Systems

Fall, 2003 – TR 8-9:15 ACR 205; Lab M 2-5 or W 6-9

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Course description:

A geographic information system (GIS) is a computerized information system that is designed to integrate various types of spatial data for a particular area and application. It is a "thematic" map database in that it allows for various "themes", or layers of data types, to be superimposed upon each other. The resultant thematic map can then be printed, published to the internet, and/or analyzed for specific, generally spatial related, queries.

This class is designed to introduce the fundamental concepts of maps and GIS, and to provide the student with experience in utilizing one of the standard desktop GIS packages: ESRI's ArcGIS. The class is "interdisciplinary" – the application of a GIS is only limited by the imagination of the individual. Typical applications of a GIS include: earth science, geography/urban planning, business management/trend and market analysis, archeology, and law enforcement.

Texts:

ESRI, 2001, Getting to Know ArcGIS Desktop, ESRI Press, ISBN 1-879102-89-7

Bernhardsen, T, 2002, Geographic Information Systems, An Introduction, 3rd edition, John Wiley and Sons, Inc., ISBN #0-471-41968-0

Optional Text:

Clarke, Keith C., 1999, Getting Started with Geographic Information Systems, 2nd Edition, Prentice Hall, ISBN 0-13-923889-1

Tentative Schedule:

Week:	**Lecture topic**	**Lecture reading**	**Lab topic:**	**Lab reading:**
20-Aug	Introduction	1		
25-Aug	History of GIS	2	Introduction, Analog maps	1,2, and handout
1-Sep	Data models, SRGIS data server	3,4, HWsrgis	Getting Started	3,4
8-Sep	Data models	5, **EX 1**	Displaying data	5, 6, 7
15-Sep	Georeferencing	6	Queries	8
22-Sep	Hardware/software	7, 8	Joins	9
29-Sep	data collection / gps data dictionary	9, 10, HWgps 1	Selection by location	10
6-Oct	data quality	11	Prep for analysis	11
13-Oct	database issues / gps data collection	12, HWgps 2	Analysis of spatial data	12
20-Oct	Housekeeping	13	projections	13
27-Oct	spatial analysis / gps data integration	14, HWgps 3	geodatabases	14
3-Nov	advanced spatial analysis	15, **EX 2**	creating and editing features and databases	15, 16
10-Nov	Visualization	16	layouts	18, 19
17-Nov	spatial analyst	tba	Spatial Analyst	Handout
24-Nov	**spatial analyst**	**tba**	**Thanksgiving, no lab**	
1-Dec	standards/metadata	19	Project work	
8-Dec	final exam / project due	**Final exam**		

Grading:

Grading will be based upon:

Attendance/quizzes; weekly labs, homework assignments, two midterms; one final exam; and a term project. There will be 15 quizzes, and 13 labs. We will drop the lowest quiz and the lowest lab score. The final point breakdown will be:

	points each	**#**	**total**	**%**
Quizzes	5	14	70	14
Labs	10	12	120	24
Homework	10	4	40	8
Exam 1	50	1	50	10
Exam 2	50	1	50	10
Final Exam	70	1	70	14
Project	100	1	100	20
			500	**100**

The final grade scheme is based upon the standard 90-100 = A, 80-90 = B, 70-80 = C, 60-70 = D, and <60 = F.

The topic of the final project will be chosen by each student. The project will involve the creation of a digital atlas of a specific 7.5 minute quadrangle in the west Texas region. Project requirements include:

A portable ArcMap project burned to CD that can be run from any computer that has Arcmap installed. This project must include the following components:

1. These basic *raster* image data types (with layer names in table of contents set to text description of layer): DRG (white set transparent), DOQ (4 for the quad, or a single mosaic), Landsat subset (needs band combinations described in layer name)

2. Digital elevation model subset to the map area with hillshade, aspect, slope, and elevation as separate layers, symbolized properly.

3. Vector data layers, clipped to the map size, and prepared as "layer" files with appropriate, understandable symbology. Minimum requirements include hypsography, TXDOT transportation, Land Use Land Cover (LULC), and soil type, vegetation, or geology. Other layer types which can be added include additional layers available from local parks (Big Bend National Park, Big Bend Ranch State Park …)

4. At least one vector layer that **YOU** create. Possible examples include GPS data (if you have access to the area), hydrography (stream patterns) and drainage basin delineation, site specific LULC, structures, and roads not included on TXDOT layers. All but the GPS data can be created by "heads-up" digitizing on-screen over an image layer that might have the features that you want to represent (an aerial photograph, for example). As always, these need to be symbolized in a meaningful way.

5. Bookmarks must be created that automatically zoom to specific areas of interest on your map. Scale dependent rendering might also be added.

All of this work teaches you the basic operations of adding a variety of data types, and how they are "georeferenced" (they are placed on top of each other based upon their real-world locations). This is a valuable skill, but only makes use of a small part of the capabilities of ArcMap.

The next step requires that you complete some type of spatial analysis using the layers that you have added. You will learn as the semester progresses about specific types of spatial analysis.

An example: As part of an archaeological study of ancient habitation sites, you discover an association, at known sites, between slope angle, slope direction, soil type, and proximity to water. In an effort to find other sites, you design a predictive GIS to: *find all of the areas on your map with south facing slopes with a slope angle between 10 and 15 degrees, and that are* *underlain by a specific soil type.* You could even refine this query to those areas that occur within 1km of a stream channel. This type of analysis would require operations on both of the two basic data types: *vector* and raster.

Up to this point, you will have created an ArcMap project that is interactive. If created properly, an uninformed user could understand the project construction. She could manipulate the project by activating various layers of interest, and zooming to areas of interest manually, or by using your “bookmarks”.

The next step includes the construction of a printable representation of the project. For this, you will need to create a “layout” that includes individual maps that show the most significant parts of your project, including the analysis component. Necessary components for a printed map include: north arrow, bar scale, fractional scale, at least two latitude and two latitude (or UTM or other equivalent) tick marks (units indicated), location map inset, title, author, date, description of projection/datum, legend, and a brief (or long) text description of the map.

The last step includes the creation of “metadata”. In this step, you create a document that describes your data (“data about your data”). This document informs a potential user about important topics such as projections, data sources, data operations, etc. Basically, it is a document that describes the technical details of your project and how you did your analysis. This is an extremely important step if you want other users to use your project. Without it, your project is of no value to other users.

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