NATR 4325/7325

INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

Winter Semester

Instructor:
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School of Natural Resources, University of Missouri-Columbia
Credit Hours: 3

Instruction and Lab Hours
W 1:00-2:00 pm (ABNR 109)
F 2:00-4:30 pm (ABNR 109)

Office Hours
By appointment

1. Course Description

Cover basic theories and techniques of GIS; emphasizes on the nature and processing of spatial information including: data representation, input, manipulation, storage, and spatial analyses; teach methodology of processing geographic information for research and applications. Prerequisite: NATR70 or GEOG247.

2. Evaluation and grading

2.1 Components of Evaluation:

Class Projects	60%
Midterm	20%
Final	20%

2.2 Grading policy:

Grades of class projects are based on:
1) the academic merit of your answers to the questions
2) clarity of answers, NO BEATING AROUND THE BUSH
3) concise and logical presentation.

2.3 Due date and time:

Each of the assignments will have a due day clearly written underneath the title of the assignment. The due time is 5:00 p.m. on the due day. Any assignment that is turned after the due time on the due day is considered late.

2.4 Penalty for late assignments

The penalty of a late assignment is based on the number of days late (including weekends!). If an assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48 hours but more than 24 hours, it is considered 2 days late,

and so on. All assignments should be turned electronically to the designated hand-in place unless specified otherwise.

Late assignments are penalized 10% per day. Here is the formula for calculating the points of a late assignment:

Points_get = Points_scored - 0.1*num_days_late*Points_scored

The minimum value of Points_get is 0. Assignments handed in after the instructor has returned the graded assignment to class (usually a week after the due date) will receive no points.

3. Prerequisites

NATR 1070 or Geog 4710/7710; Consent of instructors required.

4. Computer Environments and Software

ArcGIS with Spatial Analyst and Arc/Info on PC platform will be used for the instructions and class projects.

5. MU Statement on Academic Dishonesty

"Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor. From Provost Brady Deaton."

6. Disability Statement

Issues of Access to Instructional Materials (ADA requirements). If you need accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please inform me immediately. Please see me privately after class, or at my office.

To request academic accommodations (for example, a notetaker), students must also register with Disability Services, AO38 Brady Commons, 882-4696. It is the campus office responsible for reviewing documentation provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors, as needed and consistent with course requirements.

7. Other Important Issues

Class attendance is accounted as part of classroom participation although classroom participation also includes asking questions and engaging in discussion. There may be a time that the class is full and there are people waiting to get into the class. Those of you who are registered for this class but later decide not to take the course, please let the instructor know as soon as possible so that he can add the people on the waiting list to the class list.

Only medical reasons may be taken as excuses for turning in an assignment late or missing a class. However, you must provide a written report from a medical doctor stating your inability to attend class and/or complete an assignment.

The instructor will certainly give you ample time for each assignment. There is no reason for him to be informed that the computer is down or the software is not working a day before the assignment is due. He will NOT take this as an excuse for a late assignment!

8. Intended Topics and Structures

Week 01 Introduction

Introduction to NATR 325
What is a GIS?
GIS Operations
Organization of the class
Key concepts and terms

Lab 01: Introduction (project01)

1) Introduction to Blackboard
2) Introduction to ArcGIS
3) Introduction to computer lab settings

Week 02 Vector Data Model

Introduction
Vector data representation
Topological data structure
Non-topological vector data
Higher-level objects (TIN, Regions, dynamic segamentation)
Object-oriented data model
Spatial data concepts (scale, accuracy, precision)

Lab 02: Vector Data Model (project02)

1) The data file structure of Arc/Info coverages and shape files
2) TIN, regions, and dynamic segmentation using ArcGIS

Week 03 Vector Data Input and Spatial Data Editing

Introduction

Existing GIS data
Metadata
Conversion of existing data
Creating new data
Geometric transformation
Type of digitizing errors
Topological and non-topological editing
Topological editing
Edge matching
Non-topological editing
Other types of map feature manipulation

Lab 03: Vector data input (project03)

1) Download a digital map from the internet
2) On-screen digitizing using ArcGIS
3) Add event themes in ArcGIS
4) Use scanning for spatial data input
5) correct topological errors in Arc/Info
6) Spatial Data Editing in ArcGIS
7) Edgematch/Mapjoin/Dissolve
8) Use TRANSFORM on a newly digitized map in Arc/Info

Week 04 Attribute Data Input and Management

Introduction
Attribute Data in GIS
The relational database model
Attribute data entry
Attribute data verification
Creating new attribute data from existing data

Lab 04: Data entry and management (project04)

1) enter attribute data in ArcGIS
2) link tables in ArcGIS
3) Join tables in ArcGIS
4) Attribute data classification in ArcGIS

Week 05 Map Projection and Coordinate System

Introduction
Geographic grid
Map projection
Coordinate systems
Projection in ArcGIS

Lab 05: Projection and Coordinate System (project05)

1) Use projections in ArcGIS
2) Create a shape file from a text file and project the shape file

3) Re-project a shape file

Week 06 More Table Operations and Raster Data

Calculate

Displaying statistics

Sum, Count, Mean, minimum, maximum

Range, Variance, Standard Deviation

Summary

Sum, Minimum, Maximum

Variance, Standard Deviation

First, Last, Count

Create a Chart

Export tables

Raster Data Introduction

Elements of the Raster Data Model

Types of Raster Data

Raster Data Structure, Compression, and Files

Raster Data Structure, Compression, and Files

Data Conversion

- Rasterization
- Vectorization

Lab 06: Table operations and raster data (project06)

1) Derive the statistics of area (min, max, mean, etc.), for a given zone. Neighborhood Operation
2) Import USGS DEM Data
3) View USGS DEM data in ArcGIS
4) View a satellite image in ArcGIS

Vector to raster conversion

Week 07 Data Display and Cartography

Introduction

Cartographic symbolization

Type of map

Typography

Map design

Lab 07: Data Display and Cartography (project07)

1) making a cholopleth map
2) graduated symbol, line symbol, and type design
3) text labeling

Week 08 Data Exploration

Introduction

Interactive data exploration

Vector data query

Raster data query
Charts
Geographic visualization

Lab 08 Data Exploration (project08)

1) an overview of data exploration in ArcGIS
2) attribute data query
3) relational database query
4) combining spatial and attribute data queries

Week 09 Vector Data Analysis (coverage)

Introduction
Buffering
Map overlay
Distance measurement
Map manipulation

Lab 09 Vector Data Analysis (project09)

1) buffering, overlay, and use of Avenue script
2) distance measurement

Week 10 Raster Data Analysis

Introduction
Analysis environment
Local operations
Neighborhood operations
Zonal operations
Distance measure operations
Spatial autocorrelation

Lab 10 Raster Data Analysis (Project 10)

1) local and neighborhood operation
2) zonal operation
3) physical distance measure
4) least accumulative cost distances

Week 11 Spring break

Week 12 Terrain Mapping and Analysis

Introduction
Data for terrain mapping and analysis
Terrain mapping
Terrain analysis
Grid versus TIN

Lab 11 Terrain mapping and analysis (Project11)

1) terrain mapping and analysis using DEM
2) Viewshed analysis
3) Build and display TIN in ArcGIS

Week 13 Spatial interpolation

Introduction
Control points
Global methods
Local methods

Lab 13 Spatial Interpolation (Project12)

1) trend surface analysis using an Avenue Script
2) kernel density estimation
3) spatial interpolation using IDW
4) Comparing two methods of thin-plate Splines
5) Ordinary Kriging using an Avenue script

Week 14 GIS Models and Modeling

Introduction
GIS modeling
Binary models
Index models
Regression models
Process models

Lab 14 Independent project

Week 15 Trends in Geographic Information Systems

Platform independent
Internet based
Topology—a history?
Map objects
Non-relational databases
ORACLE
Programming tools
JAVA, VB, VC, and others
Spatial Analysis
Geostatistics
Spatial pattern metrics

Lab 15 Continue on independent project

Course Materials

Text

Chang Kang-tsung 2004. Introduction to Geographic Information Systems. McGraw-Hill Higher Education. Boston, MA, USA. (or newer version)

Tool Books

Environmental Systems Research Institute, Inc., 2001. What is ArcGIS—GIS by ESRI. ESRI Educational Services, Redlands, CA, USA.

Booth R. and Mitchell, A. 2001. Getting Started with ArcGIS—GIS by ESRI. ESRI Educational Services, Redlands, CA, USA.

Minami, M. 2000. Using ArcMap—GIS by ESRI. ESRI Educational Services, Redlands, CA, USA.

Vienneau, A. 2001. Using ArcCatalog—GIS by ESRI. ESRI Educational Services, Redlands, CA, USA.

Other GIS Books

Bolstad, P. 2003. GIS Fundamentals. Eider Press, White Bear Lake, MN, 411p.

Chrisman, N. R., 1997. Exploring Geographic Information Systems, John Wiley & Sons, New York.

Clarke, Keith C., 2001. Getting Started with Geographic Information Systems. Prentice Hall, Inc., Upper Saddle River, NJ, 352p.

Goodchild, M.F., L.T. Steyaert, B.O. Parks, C. Johnson, D. Maidment, M. Crane, and S. Glendinning (eds.). 1996. GIS and Environmental Modeling: Progress and Research Issues. GIS World, Inc., Fort Collins, Colorado, USA, 486 p.

Heit, M., H. D. Parker, and A. Shortreid (eds.). 1996. GIS Applications in Natural Resources 2. GIS World, Inc., Fort Collins, Colorado, USA, 540 p.

Ripple, William. 1994. The GIS Applications Book: Examples in Natural Resources: a compendium. American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, 380 p.

Lo, C. P. and A. K. W. Yeung. 2002. Concepts and Techniques of Geographic Information Systems. Prentice-Hall, Inc., Upper Saddle River, NJ, 492p.