

Geographic Information Systems

CIS 441

Syllabus

Fall 2003

Instructor: David Mendonça, Ph.D.
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1. Course description: Geographic Information Systems (GIS) allow individuals and organizations to pose, explore and answer a variety of public- and private-sector questions using spatial data. In this course the student will learn to identify, manipulate and analyze spatial data using state-of-the-art software. The course is project-driven and hands-on: students will define and address real problems using real data. The course will also cover selected topics in information visualization as they relate to the use of GIS.

A. Course number, title, credits: CIS-441, Geographic Information Systems, 3 credits

B. Prerequisites: CIS 431 (Intro. Database Systems)

C. Narrative description: GIS technologies are used by individuals and organizations to formulate and solve problems that require analysis of spatio-temporal data (e.g., spatial patterns in household median income in metropolitan New York-area neighborhoods from 1980 to present). GIS technologies are used in a variety of fields, including marketing (e.g., in targeted advertising), policy analysis (e.g., in Congressional redistricting) and engineering management (e.g., in infrastructure management). GIS technologies can be powerful tools in part because they communicate through information visualization, thus drawing on a core human capability. Accordingly, visualization tools such as GIS can serve as the *lingua franca* among a wide variety of individuals and organizations. This course therefore contributes to the “systems thinking” approach used in Information Systems (IS), Information Technology (IT) and Computer Science (CS) fields.

The course takes students through the life-cycle of spatio-temporal data and has three main phases: (i) rudiments of spatio-temporal data; (ii) advanced GIS concepts such as map understanding, data transformation, spatial analysis and data visualization; (iii) GIS for problem-solving and decision-making. Students in the course are also expected to learn how to design effective information visualizations for GIS applications.

2. Purpose of the course

- **Why take this course?** The course is useful for at least three reasons: (i) fluency in GIS technologies and related theory will help qualify students for employment in a wide range of sectors; (ii) the course provides training in visualization methods for spatio-temporal data; and (iii) the course could potentially be included as part of a number of concentrations (e.g., Infrastructure Systems, Multimedia) and can serve as a valuable elective for IS and CS majors as well as for students in other majors who choose a minor in CS, IS or Scientific Computing.
- **Reason for prerequisite:** Use of GIS requires understanding of fundamentals of relational database design and querying. Students will immediately begin supplementing this understanding with knowledge about the particular features and challenges of spatio-temporal databases.

3. Course details

A. Required textbook

- Lo, C.P. and Yeung, A.K.W. (2002). *Concepts and Techniques of Geographic Information Systems*. Prentice Hall.

B. Optional References

- DeMers, M..N. (1999). *Fundamentals of Geographic Information Systems*. 2nd Ed., Wiley Press.
- Burrough, P.A. and R.A. McDonald (1998). *Principles of Geographical Information Systems*. Oxford University Press.

C. Softwares

- The course will use ArcGIS, which is produced by ESRI. The software is free to NJIT students (though there may be a cost for media) and is also installed on the classroom machines. See www.esri.com for background information on the software.
- For project work, it will also be helpful to have a good working understanding of one word processing program (e.g., Microsoft Word) and one image manipulation program (e.g., Adobe Photoshop, Microsoft PowerPoint).

D. Number of hours of lecture and laboratory: three lecture hours per week, including both lecture and laboratory sessions.

4. Course Outline with Due Dates

Week	Topics
1	Course Objectives and Overview Conceptual Framework of GIS
2	GIS Structure & Function Coordinate Systems
3	GIS Data Database Design & Development
4	Database Design & Development Function and Structure of Maps
5	Overview of Public Data Sources Basic GIS Operations
6	Basic GIS Operations
7	Fundamentals of Data Visualization Advanced Querying <i>Mid-term Exam (15 Oct)</i>
8	Linear Operations on Spatial Data <i>Project One Due (22 Oct)</i>

Week	Topics
9	Spatial Modeling and Analysis Data Visualization and Presentation for GIS
10	GIS Modeling Spatial Interpolation
11	Error Evaluation and Management GIS for Decision Making 1
12	GIS Organization and Management GIS for Decision Making 2
13	GIS Applications <i>Thanksgiving Recess</i>
14	Internet GIS
15	Discussion and Course Evaluation <i>Project Two Due (10 Dec)</i>

Note: Final exam will be given during exam week.

5. Performance Assessment

Projects

- Project One: “GIS Fundamentals: Producing maps from public data sources”
- Project Two: “GIS for Decision Making: Supporting decision making using visualizations of data from public data sources”

Quizzes

- Four in-class quizzes will be given over the course of the semester. They will pertain to the application of GIS theory using computer software.

Exams

- Mid-term Exam will cover all theoretical material up to and including material presented in week 6.
- Final Exam will cover all theoretical material presented in the course.

Summary

<i>Metric</i>	<i>% of Final Grade</i>
Project One	15
Project Two	25
Quizzes	15 (5% each, using three best)
Mid-term Exam	20
Final Exam	25

Note on due dates:

All assignments (projects, laboratory quizzes, exams) must be submitted by their due date and time, as follows:

- projects are due at the beginning of class (i.e., 10:00am) on the project due date;
- quizzes are same-day quizzes given in-class; and
- exams are same-day exams given in-class.

Late assignments will not be accepted. Make-up assignments will only be given when (i) the event which caused the student to be late is sufficiently serious (e.g., a death in one’s immediate family) and (ii) documentation of the event is provided to the instructor in written form (e.g., a doctor’s note or a death notice).

6. Electronic Communications

Messages about the course will be sent to you periodically via email. Unless you notify me otherwise, the email address specified for you in the NJIT directory will be used.