Course Home

GEOG-G 438 ADV GEOGRAPHIC INFO SCIENCE (3 CR)
06:00P-08:40P M CA 008C Banerjee R

GEOG-G 539 ADV GEOGRAPHIC INFO SYSTEMS (3 CR)
06:00P-08:40P M CA 008C Banerjee R

Advanced Geographical Information Science
Department of Geography
Indiana University-Purdue University, Indianapolis

SPRING 2013

Syllabus

Course Description

- *Intermediate and advanced topics in geographic information science and spatial analysis using GIS software.*
- *Advanced course for upper-division undergraduate and graduate students seeking greater understanding of GIS theory, technology, and applications.*
- *Exercises focus on development, management, and analysis of GIS data. (Lecture/Lab).*

Course Objectives

The objectives of this course are five:

- To integrate GISc as Complexity Science of Earth surface phenomena (both physical and human)
- To explore the foundations of Geographic Information Science (GISc) and Engineering (related mathematical and statistical theory) at a level and depth appropriate for someone aspiring to study higher-level applied science and/or to become a professional Geographic Information Scientist.
- To present an introduction to the field of topology, with emphasis on those aspects of the subject that are basic to advanced spatial analysis and GISc.
- To introduce the student to what it means to do advanced GISc such as spatial analysis, as opposed to learning about spatial analysis or to learning to do exercises.
- To help the student learn how to write GISc and spatial analysis text according to the standards of the profession.
- To develop competence in handling large multivariate spatial analysis.

Staff

Instructor:
Rudy Banerjee, PhD

Associate Professor

Course Meeting Times

Lectures:
One session / week
3 hours / session

Level

G438 Undergraduate/G539 Graduate

Office Hours:

Mondays and Tuesdays 5 p.m. - 6 p.m.
Or by appointment only

Teaching Home Page

http://www.iupui.edu/~geogdept/

Credit Hours

3.0

Feedback

Send feedback to Rudy Banerjee (rbanerje@iupui.edu) about this course.

Prerequisites

G338/538: Introduction to Geographic Information Systems, equivalent introductory course/experience, or consent of instructor.

Nature of the Course:
Designed as the sequel to the introductory course in GIS (G338/538), G438/539 broadens understanding of geographic information science theory and spatial analysis methodologies. The course places a strong emphasis on building hands-on skills as well as theoretical knowledge in spatial analysis based on **Network Theory and Graph Theory**. Each class meeting is comprised of a lecture and laboratory portion. Journal articles and online lecture materials are used to build understanding in geographic information science theory and application. Lab assignments focus on building skills and knowledge important for modern geographers and students of other disciplines who incorporate GIS technology in their research.

Course Format:
Each class session will be comprised of a lecture and laboratory portion (except for exam dates). Readings from the text, outside sources, and supporting lecture materials provide a fundamental background in GISc theory. Lab assignments focus on building skills important for modern geographers and students of other disciplines who incorporate remote sensing technology in their work.

Facilities and Software:
Each class meeting will occur in the Social Science Computing Classroom, Cavanaugh Hall Room 008C.
http://www.iupui.edu/~ctsin/roomdb/roomdetail.php?room=181

Open lab hours for the classroom is listed weekly outside classroom.

Some faculty will permit students from other courses to use the lab during class times as long as there are extra seats available and the student does not interrupt the classroom. Contact the instructor before hand to verify that you will be permitted to use the lab during scheduled class times.

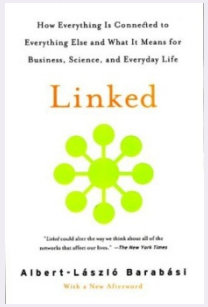
- There is one text book required for the course. Selected journal articles and excerpts from a variety of texts illustrating GIS theory and applications constitute the primary reading material. These will be provided by the instructor through reference to electronic resources.
- Students should purchase some form of media on which to back up their data. Available hardware in the lab include CD/RW drives and USB ports. As an alternative, material could also be backed up on a network account. ***It is strongly recommended that you regularly back up your data (at the conclusion of each class meeting), making TWO backup copies in case of media failure.***
- Students are solely responsible for managing their data.
- Aside from class meeting time, data cannot be stored on hard drives of the computers in the lab; these are purged regularly.

Evaluation:
Examinations
Exams include a combination of short essay questions, quantitative problems, and interpretation tasks. Exam content emphasizes theory and application covered in lectures, assigned readings, and laboratory exercises - there are no hands-on computer components to exams. Exam dates are finalized at least two weeks in advance. In general, they will occur at the middle and end of the semester (the 2nd exam is not cumulative). "Make-up" exams will not be given. Notify the instructor at least one week in advance of a scheduled exam date if an alternative date is necessary.

Exercises
The laboratory portion of the course will consist of a series of 10 or 11 exercises. A significant portion of each class meeting will be reserved for students to work on laboratory assignments (usually 1/2 of each class meeting or more). Depending upon the pace of the course, there are also one or two open lab sessions scheduled during class time. Extra time will be required to complete exercises in addition to lab time provided during class hours . In other words, you will need to come to the lab to complete assignments outside of scheduled class time.

Submission of assignments in hard copy format not allowed. Only electronic copies are permitted.

Text Book



There are no primary textbooks for this class. However, a supplementary textbook is available to help with the fundamentals of networks. In addition, journal articles, papers, web documents and digital multimedia will be provided by the instructor from time to time.

A supplemental Textbook is assigned:

Linked: How Everything Is Connected to Everything Else and What It Means (Paperback)

by Albert-Laszlo Barabasi

An optional textbook is suggested for those who require additional introductory GIS (especially for those who have not taken the GISc class in Fall of 2012 at IUPUI).

Class Policies:

Student Responsibilities - Students are expected to abide by the rules and regulations of Indiana University. In addition to general University policies, students in this course are expected to attend every class, take lecture notes, review assigned readings before class, complete assignments and examinations on time, and participate in class discussion.

Attendance - We will be covering a large amount of material and the majority the subject matter on which you will be tested will be emphasized in lectures. In addition, completion of advanced lab assignments will require you to call upon theory and techniques covered in previous classes. Consequently, your success in this course will depend greatly upon your attendance. Perfect attendance is strongly recommended. Students, who miss two consecutive classes, should notify the instructor and provide an explanation. Otherwise, students will be contacted by the University and be required to document that they have not unofficially withdrawn from the class.

Academic Honesty- Students are encouraged to help each other in their work during lab sessions. Procedures such as copying basic data may be necessary. If you find something interesting, share it with your classmates. However, final products as turned in to the instructor must display evidence of individual initiative and creativity. It is assumed that students taking this class will live up to the highest levels of academic honesty. Cheating or plagiarism will result in a final grade of F.

Liability Warning - Students are responsible for all activities on their computer accounts. Keep your user name and password confidential.

Expectations

We will deal with materials in lectures and exercise sessions since all materials cannot be in the text. The technological theoretical aspect will be comprehensively covered but students are not expected to know advanced spatial analysis.

Each individual should provide all exercise solutions. In addition, graduate students should submit a final project in a portfolio format at the end of the semester. This will satisfy the professional requirements of working in a comprehensive GISc environment. Exercises will be evaluated to determine grade. Exams grades will guarantee whether one has mastered the concepts.

Optional problems will be provided for those intending to use knowledge acquired in this course to help with their dissertation.

Grading

Grading will be, as follows:

ACTIVITIES	POINTS
Problem Sets/Exercises	100
Midterm Exam	100
Final Exam	100
Student Project	50
Final Grade	350

Grading Scale:

Letter of Points	Percentage Grade Earned
A+	97-100
A	93-96
A-	90-92
B+	86-89
B	83-85
B-	80-82
C+	76-79
C	73-75
C-	70-72
D+	66-69
D	63-65
D-	60-62
F	< 60

Principles of Undergraduate Learning (PUL) Objectives:

The PUL objectives addressed by this course include:

1. Core Communication and Quantitative Skills

Definition: The ability of students to write, read, speak and listen, perform quantitative analysis, and use information resources and technology--the foundation skills necessary for all IUPUI students to succeed.

Outcomes: This skill is demonstrated in this course by the ability of students to:

- comprehend, interpret, and analyze texts
- solve problems that are quantitative in nature
- make efficient use of information resources and technology for personal and professional needs

2. Critical Thinking

Definition: The ability of students to analyze carefully and logically information and ideas from multiple perspectives.

Outcomes: This skill is demonstrated in this course by the ability of students to:

- analyze complex issues and make informed decisions
- synthesize information in order to arrive at reasoned conclusions
- evaluate the logic, validity, and relevance of data
- solve challenging problems
- use knowledge and understanding in order to generate and explore new questions

Accreditation Board for Engineering and Technology (ABET) Objectives:

The ABET objectives addressed by this course include:

- demonstrating appropriate mastery of the knowledge, techniques, skills, and modern tools
- the ability to identify, analyze, and solve technical problems
- demonstration of effective communication
- develop a commitment to quality, timeliness, and continuous improvement

SUGGESTED TOPICS FOR INDEPENDENT PROJECT

- **TBA**

Additional Readings

1. G. Chaitin, \The limits of reason," Scientific American 294,No. 3 (March 2006), pp. 74:81.
2. **G. Chaitin, Meta Math!, Pantheon, New York, 2005.**
3. G. Chaitin, \The halting probability : Irreducible complexity in pure mathematics," Milan Journal of Mathematics 75 (2007), in press.

Assignments

- **Weekly Exercises**
- We encourage collaboration on the weekly exercises; you can learn a good deal from your fellow students.. If you can't do all of a problem, see me …
- **Discussion Group**
- We invite scholars, teachers, students, and self-learners interested in "**Course G438/539: Advanced Geographic Information Science**" and encourage their interaction with others through the Discussion Group for this course.

Calendar

Week of:	TOPICS	TIMELINE	CHAPTER
7-Jan	Course Introduction: GISC & COMPLEXITY SCIENCE **Simulation GIS: The future?**Logic and Foundations in Spatial Analysis; Spatial Data: challenges and opportunities; GIS Software: TransCAD™, QuantumGIS™ and ArcGIS™	Introduction to the SSCC **Exer 0:** Re-Introduction to GISc (not graded)	The First Link: Introduction
14-Jan	RANDOM NETWORKS Topological Spatial Analysis; Ask and Answer Geographic Questions part i:Areas of Influence; Adjacency Tools; Orders of Adjacency	**Exer1:** Orders of Adjacency	The Second Link: The Random Universe
21-Jan	**MLK Holiday**		
28-Jan	SMALL WORLDS Ask and Answer Geographic Questions part ii: Bands; Districts; Spatial Interaction models: Single vs. Multi Layer Operations	**Exer2:** Spatial Interaction: Multi Layer Operations	The Third Link: Six Degrees of Separation
4-Feb	SMALL WORLDS (CONTD.) Intro to graphs and networks theory used in spatial models; Density Grids; TINS Introduction to Matrices	**Exer3:** Matrices	The Fourth Link: Small Worlds
11-Feb	NETWORK SCALES **Basic Network Analysis:**Traveling Salesman Problem, Partitioning a Network, Creating Network Buffers, Intersection Diagrams	**Exer4:** Network Analysis 1	The Fifth Link: Hubs & Connectors
18-Feb	NETWORK SCALES: SCALE-FREE? **Advanced Network Analysis:** Connecting Features to a Network; Voronoi Polygons as networks	**Exer5:** Network Analysis 2	The Sixth Link: The 80/20 Rule
25-Feb	NETWORK SCALES: SEVERITY **Advanced GIS Analysis Tools (REVISION):** Combining Attributes; Converting Lines and Areas; Assigning Customers; Joining data to a Map: Creating a relational join	**Exer6:** Data Join using relational algebra; SQL & Python Introduction	The Seventh Link: Rich Get Richer
4-Mar	**Exer 1-5 &Midterm Exam Due March 8**	**Open Lab**	
11-Mar	**SPRING BREAK**		
18-Mar	NETWORK SCALES: NETWORK MELTDOWNS	**Exer7:** Visibility Analysis	The Eighth Link: Einstein's Legacy
25-Mar	NETWORK SCALES: NETWORK SUSEPTIBILITY (optional)Visualizing Spatial Data; Visibility Analysis; kriging	**Exer8:** Network Analysis 3	The Ninth Link: Achilles' Heel
1-apr	NETWORK SCALES: NETWORK SUSEPTIBILITY Network Analysis, Shortest path routines, Network partitioning and Advanced Traveling salesman models	**Exer9:** Network Analysis 4: Site Location Modeling	The Tenth Link: Viruses and Fads
8-Apr	NETWORK SCALES: NETWORK EVOLUTION Territory Management and Site Location Modeling	**Exer10:** Network Analysis 5: Generating network topology	The Eleventh Link: The Awakening Internet The Twelfth Link: The Fragmented Web
15-Apr	NETWORK SCALES: NETWORK COMPLEIXITY? ***Advanced Network Analysis***	**Project**	The Thirteenth Link: The Map of Life The Fourteenth Link: Network Economy
22-Apr	COMPLEXITY AS A RESULT OF NETWORK EVOLUTION ***(Optional):****Spatial Generalized Linear Models; spatial autoregressive models*	**Project**	The Last Link: Web Without a Spider Hierarchies and Communities
29-Apr	**Review**	***END OF CLASS period***	**Short Project Presentations (6 mins)**
3-May	**Exer 6-10, Project & Final Exam due May 4**		
9-May	**Grades available on Oncourse**		