

# **GEO 344: Geographic Information Systems III**

Spring 2011-2012 | Department of Geography | DePaul University

Time: Mon/Wed 9:40-11:10 am

Location: SAC 224 (GIS Lab) in LPC

## **1. Instructors**

Sungsoon (Julie) Hwang

-Contact: shwang9@depaul.edu, (773) 325-8668

-Office: Room# 4513, 990 W Fullerton Ave, LPC

-Office hour: Tue/Thur 1-2 pm or by appointment

Mia Robidoux (Lab Assistant)

-Contact: mia.amelie@gmail.com

-Lab hour: Mon/Wed 8-9:30 am

## **2. Course Description**

GEO 344 is an advanced-level GIS course. Students conduct spatial analysis of sustainability issues of their interests. Topics include geographic visualization, network analysis, spatial interpolation, and exploratory spatial data analysis. Instruction is accomplished through lectures and hands-on computer lab exercises using ArcGIS. This course is formerly known as GEO 244. Prerequisite(s): GEO 242 or consent of instructor.

## **3. Learning Goals**

- Understand concepts and techniques for estimating z values from continuous field data (like temperature, and ozone) known as spatial interpolation
- Understand concepts and techniques for exploring spatial pattern from event data (like crime, and disease) known as point pattern analysis
- Understand concepts and techniques for finding best route, creating service areas, and analyzing OD cost matrix calculated on network distance, known as network analysis
- Understand concepts and techniques for modeling water flow, and delineating sub-waterbasin from DEM data, known as hydrological modeling
- Understand concepts and techniques for analyzing relationship among layers, including combining layers, conducting map algebra and correlation analysis
- Understand concepts and techniques for analyzing change in spatial distribution over time, including animation

## **4. Learning Outcomes**—after completing all requirements, you should be able to

- Conduct spatial interpolation appropriately with its limitations in mind
- Conduct point pattern analysis appropriately with its limitations in mind
- Conduct network analysis appropriately with its limitations in mind
- Conduct hydrological modeling appropriately with its limitations in mind
- Make animated maps
- Choose GIS techniques appropriate for a geographic inquiry for exploring a sustainability issue, and conduct spatial analysis appropriately
- Discern the utility of geospatial thinking and GIS in understanding sustainability challenges

## **5. Course Readings**

Christopher Lloyd's Spatial Data Analysis: An Introduction for GIS Users by Oxford University Press (2010)—available at college bookstore. Additional readings are posted as PDF files on D2L.

## 6. Outlines of Topics & Tentative Schedules

Wk	Date	Topics	Labs	Paper
1	3/26	Course overview		
	3/38	Exploring sustainability issues using GIS	Suggestions for paper topic	
2	4/2	1. Spatial Interpolation	1. map ozone levels	
	4/4			
3	4/9	2. Point Pattern Analysis	2. where are crime hot spots?	Article
	4/11			
4	4/16	3. Network Analysis	3. where to locate a distribution center for public library?	
	4/18			
5	4/23	4. Hydrological Modeling	4. track pollution along stream	Proposal
	4/25			
6	4/30	5. Analyzing Spatial Relationship	5. is asthma (health care access) related to ozone level (income)?	
	5/2			
7	5/7	6. Analyzing Changes	6. animate change in income inequality & land cover	
	5/9			
8	5/14	Paper help		Progress
	5/16			
9	5/21			
	5/23			
10	5/28	Presentation		Pres.
	5/30	Presentation		Pres.
11	6/4	Paper due 11am on D2L		Paper

## 7. Grading Scheme

<u>Grading Breakdown</u>		<u>Grading Scale</u>	
<b>Participation</b>	<b>10 %</b>	A	= 93-100%
<b>6 labs</b> (each 3 pts)	<b>18 %</b>	A-	= 90-92.99%
<b>6 assignments</b> (each 5 pts)	<b>30 %</b>	B+	= 87-89.99%
<b>Paper</b> (including milestones)	<b>42 %</b>	B	= 83-86.99%
		B-	= 80-82.99%
		C+	=77-79.99%
		C	=73-76.99%
		C-	=70-72.99%
		D+	=60-69.99%
		D	=50-59.99%
		F	=0-49.99%

**Participation:** assigned according to the criteria below

- A (9 - 10) = Student is present in all or nearly class meetings, and prepared, at all times, to respond to questions. Student is an active participant in small group activities, in and out of class, and in class-time activities stays on task.
- B (8 - 9) = Student participates as above, 75% of the time.
- C (6.5 - 8) = Student does not volunteer comments; responses demonstrate vague familiarity with course readings. Student is a passive member of small group activities and/or does not stay on task during class-time activities.
- D (5 – 6.5) = Student never volunteers, cannot respond to direct questions, keeps silent during class discussions and is unable to summarize readings if asked.
- F (0-5) = Student misses many class sessions and/or sits silently in classes when present, or is disruptive and non-participatory in the classroom.

**Labs:** learn advanced-level ArcGIS on course topics following instructions. Submit short answers to questions for each lab. Labs will be completed individually in class when instructors are present under most circumstances. If you can't complete the lab in time, make arrangement with a lab assistant.

**Assignments:** six assignments are given at the end of each lab. Complete a task similar to each lab without instructions (independently), but you are encouraged to consult instructors for advice. Unless noted otherwise, assignments are due one week after assignments are handed out.

**Paper:** you are to write a term paper about any sustainability issue of your interest. The term paper must employ advanced methods of spatial analysis to explore geographic dimensions of sustainability issues. It means that the paper should be an empirical paper. Literature review or conceptual paper does not count as an empirical paper. You need to analyze empirical data spatially to meet requirements of a term paper.

To assist you to choose a relevant topic and further specific research questions, we will have discussion on sustainability and GIS throughout the class. In the first week, I will initiate discussion on the concept of sustainability, and potential of GIS in advancing sustainability. During week 4 to 7 on Wednesday, you will present the summary of an article that represents your research topic. The article should be concerned with sustainability. An article that examines the use of GIS in addressing a sustainability issue of your interest is the most ideal one. To help you be on track in schedule, there are several milestones as follows:

By week 3, you should let instructors know what article you are going to present. Provide a reference of an article (author, year, title, and source). The article should be chosen carefully so that this will get you started, and provide educational opportunities to others in gaining a better understanding what sustainability is, and in what way GIS is used to understand sustainability issues. The article should be of credible sources (such as scientific journal articles, chapters of book written by experts). Sources like newspaper articles are not likely to be accepted. You can consider this to start the process of building your own annotated bibliography. Article list accounts for two points.

By week 5, you should submit a one-page proposal to your research. In the proposal, you should address what area of topic you are interested in, what research questions you are to address, and what data you are going to use. Proposal accounts for five points.

By week 8, you should submit a one-page progress report of your research. In the progress report, you should report on what has been done so far, any problems you have encountered, and so on. It is important that the progress report should demonstrate the fact that you have already started looking into data (including assessing data quality, and pre-processing data), and start spatial analysis in a preliminary level (at least mapping). If your progress report does not demonstrate you have met these requirements, full score will not be granted. Progress report accounts for five points.

In week 10, everyone will present their work in the class. Presentation accounts for five points.

Term paper (worth 25 points) is due June 4<sup>th</sup> by 11am on D2L during a final exam week.

**Late Work Policy:** Late work can be accepted with the reduction of 25% of the grade per day being late. For instance, if you turn in labs 4 days after due dates, no points will be granted.

**Makeup Exam/Incomplete Grade Policy:** A makeup exam or an incomplete grade can be arranged or granted only when credible dire and documented medical or family situations arise and these circumstances are communicated in a timely fashion.

**Attendance/Absentee Policy:** Consistent with university's policy, all students are expected to attend class meetings. Unless absence is explained on medical or compassionate grounds (documentation is required), absence from any classes is grounds for a grade adjustment.

## 8. Readings & Learning Objectives

### Week 1: GIS and Sustainability

Grainger. 2005. Introduction. In Purvis, Martin and Alan Grainger, eds. *Exploring Sustainable Development: Geographic Perspectives*. Earthscan: 1-9.

Hwang. 2012. Placing GIS in sustainability education. Unpublished manuscript.

- Define sustainability (or sustainable development)
- Discuss how geographic perspectives (concepts) contributes to sustainability
- Discuss how sustainability issues can be explored using GIS

### Week 2: Spatial Interpolation

Lloyd (the text) chapter 9 spatial interpolation

Burrough and McDonnell. 1998. Creating Continuous Surfaces from Point Data (Chapter 5) & Optimal Interpolation Using Geostatistics (Chapter 6). In: *Principles of Geographical Information Systems*. Oxford University Press: 98-141.

- Describe three elements of semivariogram model—sill, range, and nugget
- Describe how Kriging determines parameters, such as weights
- Compare and contrast IDW, and ordinary Kriging
- Discuss how to validate and improve accuracy of spatial interpolation

### Week 3: Point Pattern Analysis

Lloyd chapter 7 exploring spatial point patterns

O'Sullivan and Unwin. 2005. Chapter 4: point pattern analysis. In *Geographic Information Analysis*: 77-113

- Describe nearest neighbor analysis (NNA)
- Describe kernel density estimation (KDE)
- Describe K function
- Discuss relative strengths and weaknesses of different techniques for point pattern analysis

#### Week 4: Network Analysis

Anselin. 2005. Interactive Techniques and Exploratory Spatial Data Analysis In Longley et al, eds. *GIS: Principles, Techniques, Management and Applications*. Wiley: 253-266.

Lloyd chapter 6 network analysis

- Articulate tenets of Exploratory Spatial Data Analysis (ESDA), including its components, distinguishing characteristics, and utility
- Describe network data model (link-node or edge-junction model)
- Describe operations for network analysis, including finding the best routes, creating service areas and Origin Destination (OD) cost matrix based on transportation network

#### Week 5: Hydrological Modeling

Maidment. 1993. GIS and Hydrological Modeling. In Goodchild et al, eds. *Environmental Modeling with GIS*. Oxford University Press: 147-167.

Lloyd chapter 10 analysis of grids and surfaces

- Describe spatial components in hydrologic modeling
- Describe operations for hydrological modeling, including calculating flow direction & accumulation, and delineating sub-waterbasin from DEM (Digital Elevation Model)

#### Week 6: Analyzing Spatial Relationship

Lloyd chapter 5 combining data layers

Mitchell. 2005. Analyzing geographic relationships In: ESRI Guide to GIS Analysis Volume 2: 191-226

- Describe techniques for overlay analysis, including spatial join, polygon overlay, and map algebra (raster overlay)
- Describe techniques for proximity analysis, including buffering, and distance tool
- Describe techniques for correlation analysis

#### Week 7: Analyzing Change

Yuan. 2007. Adding Time into Geographic Information System Databases. In Wilson P. Wilson and A. Stewart Fotheringham, eds. *Handbook of Geographic Information Science*. Blackwell: 169-184.

Kraak and Ormeling. 2009. Mapping time In: *Cartography: Visualization of Spatial Data*. Prentice Hall: 152-158

- Describe how time can be represented in GIS database
- Describe how time can be mapped in GIS
- Describe different techniques for analyzing change, including mapping change, conducting overlay over temporal layers, and animation

## 9. Miscellaneous

**Academic Honesty and Plagiarism:** Academic honesty and integrity are expected at all times. Academic dishonesty, such as cheating or copying during exams, will be punished severely. Plagiarism – using someone else’s work without acknowledgment and, therefore, presenting their ideas or quotations as your own work – is strictly forbidden. DePaul University officials will be informed of any instance of academic dishonesty and notification will be placed in your file. Please read the DePaul Academic Integrity Resources page (<http://academicintegrity.depaul.edu/Resources/index.html>) for definitions and explanations of plagiarism and the University’s Academic Integrity expectations for students. Cutting and pasting text taken directly from a web-site without appropriate referencing and quotation marks is plagiarism and is forbidden. Submitting work that has any part cut and pasted directly from the internet is grounds for an automatic grade of zero.

**Accommodations:** Any student who requires assistance is asked to contact the University’s Office of Students with Disabilities (Phone 773/325-1677, TTY 773/325-7296, Fax 773/325-7396, [http://studentaffairs.depaul.edu/students with disabilities](http://studentaffairs.depaul.edu/students%20with%20disabilities)). They will be able to assist both student and faculty. If you have a condition that requires accommodation from the Productive Learning Strategies program (PLuS Program) please contact them at the Student Center room 370 (Phone 773/3251677 or online: <http://studentaffairs.depaul.edu/plus/>)

**University Center for Writing-Based Learning:** Collaborates with writers from all disciplines, backgrounds, levels of expertise, and roles within the University community. Their goal is to help develop better writers along with better writing and reflection through continual revision. If you need assistance with writing assignments, they can be contacted at: 773.325.4272 (LPC) or [wcenter@depaul.edu](mailto:wcenter@depaul.edu)

### SAC 224 OPEN HOURS FOR GEO STUDENTS

Day	Time
Mondays	8:00 - 9:30 AM & 6:00 - 9:15 PM
Tuesdays	8:00 - 9:30 AM & 4:20- 9:15 PM
Wednesdays	8:00 - 9:30 AM & 6:00 - 9:15 PM
Thursdays	8:00 - 9:30 AM & 4:20 - 5:50 PM
Fridays	8:00 AM -5:00 PM
Saturday	1:00 - 4: 00 PM
Sunday	1:00 - 4: 00 PM

These lab open hours do not overlap with LSP 120/121 tutoring effective as of now.

## Appendix A. Department of Geography Learning Goals

GEO344 addresses learning goals 1, 2, 5, 6, and 7.

Courses in the Department of Geography teach students:

1. Understand spatial patterns and processes of modification of the Earth's physical and cultural landscapes
  - (a) As social constructions.
  - (b) As systems that link the Earth with human society in interdependent, dialectical relationships, and
  - (c) Through mapping and visualization.
2. Understand the concept of scale as a spatial phenomenon that ties the local, the regional, the national, the transnational, and the global in a system of interaction.
3. Understand the phenomenology of the discipline of Geography—most importantly, “space”, “place”, “landscape,” “region,” and “location”.
4. Distinguish that spaces, places, and so on, may have both objective and subjective/symbolic dimensions.
5. Develop research and writing competences that would allow you to:
  - (a) Formulate a cogent research question about the spatial character of a physical, socio-cultural, or environment-societal phenomenon,
  - (b) Write about it in ways that reflect analytical and critical thinking, and
  - (c) Ethical concern over social and environmental justice, consistent with the University's social mission.
6. Engage competently in qualitative and quantitative spatial analysis, and with exercises that are concerned with explaining spatial regularities (for example, the spatial calculus behind the location of retail commerce in Chicago, or transnational flows of capital).
7. Learn the basic utility and use competently one or more of the information technologies that are now redefining the logistical limits of spatial analysis: geographic information systems (GIS) and remote sensing.
8. Achieve greater general knowledge of the world, its regions, its physical systems, its cultures, and political-territorial divisions.

## Appendix B. Harvard Referencing Style

### Reference Lists:

Reference lists must be in alphabetical order by author's last name. Items by the same author must be in chronological order. Indent all but the first line of the citation. Please use the following style:

*When referencing a direct quotation:*

Knox and Pinch (2000: p.172) argue that "social polarization has been taking place."

*When referencing an idea:*

According to Knox and Pinch (2000), there has been social polarization.

### Books:

Knox, Paul and Steven Pinch. 2000. *Urban Social Geography: An Introduction*. 4<sup>th</sup>ed. Englewood Cliffs, NJ: Prentice Hall.

### Book chapters in an edited collection:

Beauregard, Robert A. 1986. The Chaos and Complexity of Gentrification. In Smith, Neil and Peter Williams, eds. *Gentrification in the City*. Boston: Allen and Unwin: 35-45.

### Journal articles:

Borchert, John R. 1967. American Metropolitan Evolution. *The Geographical Review* 57(3): 301-332.

### Internet articles:

Gray, Geoffrey. 2003. Bad for Business: Budget Cuts Threaten Small Manufacturers. *City Limits Weekly* #411. [www.citylimits.org](http://www.citylimits.org). Accessed May 5, 2008.