

ADVANCED GEOGRAPHIC INFORMATION SYSTEMS PDD/UST/PAD/ENV 643, FALL 2009

Sung-Gheel (Gil) Jang

Day & Time: Tuesdays, 6-9:50 p.m.
Location: UR 39
Instructor: Dr. Sung-Gheel Jang
Office: UR 349
E-mail: s.jang75@csuohio.edu
Phone: (216) 687-5597
Office Hours: Tuesday 4-5 p.m. and by appointment
Prerequisite: UST/ENV/PAD/PDD 642 or equivalent

Course Description

This course covers advanced concepts and principles of Geographic Information Systems/Science (GIS) with a particular emphasis on key concepts and analytical methods of geographic information, spatial databases, applications, and web services. While the lecture/discussion sessions cover underlying theory, lab sessions are organized to give students an opportunity to learn for themselves how to put those concepts and theory into practice through hands-on exercises with ESRI ArcGIS, open source GIS tools, and spatial databases. Upon completion of the course, successful students should be able to apply what they have learned immediately to their own research work and in their future professional careers.

Course Objectives

The specific objectives of the course are:

- Understand in-depth concepts underlying Geographic Information Systems/Science, including spatial concepts and representation, models of geographic information, essential spatial analysis methods, and uncertainty in geographic information;
- Explore the underpinnings of spatial databases, including data model, spatial query, and storage and indexing;
- Examine varied GIS application to let students have tangible ideas on how GIS will contribute to real practice and research;
- Discuss advanced techniques for sharing geographic information such as web-based GIS, metadata, interoperability, and spatial data infrastructure; and
- Integrate concepts of GIS theory and methodology with technical skills to design, implement and present a GIS project

Requirements

The course consists of lecture/discussion sessions and lab exercises. The students should attend both sessions and complete the following requirements: class discussions/participation; in-class lab assignments; homework assignments; a take-home exam; and a final term project with a paper.

1. Class discussions/participations

You are expected to 1) read all assigned readings prior to class; 2) *submit discussion questions to the course Blackboard by 9 a.m. the day of class*, and 3) come to class ready to participate.

2. In-class lab assignments

Every lab exercise includes an in-class assignment to practice what you have learned in the lab session. Students should submit the assignment by 9 a.m. the day of next following class.

3. Homework assignments

The homework assignments will help you figure out how to use the methods and techniques you have learned in class to solve research problems. You will be provided with a problem context, and a set of questions that are to be addressed.

4. Take-home exam

A take-home exam will be taken in lieu of midterm. The take-home will provide students with an opportunity to review the concepts and methods that they have learned during the first half of this course.

5. Final project

Students should conduct an individual project based on their interests and present their project with a final paper at the end of the semester. A specific instruction on its scope and content will be provided in the mid-point of the course.

Grading Policy

The course grade will be determined as follows:

Class Discussions/Participations	10%
In-Class Lab Assignments	10%
Homework Assignments	25%
Take-home Midterm Exam	20%
Proposal Presentation	5%
Final Presentation	5%
Final Paper	25%

Grading scale:

A = above 93%, A- = 87-92.9%, B+ = 81-86.9%, B = 75-80.9%, B- = 70-74.9%,
C = 60-69.9%, and F = below 59.9%

TEXTBOOK/READINGS:

There is **no** required textbook for this course. All course readings, lecture notes, and lab materials will be available via the CSU Blackboard system (<https://elearning.csuohio.edu/webct/entryPageIns.dowebct>).

Recommended books:

Longley, P. A. et al. (2005). *Geographic Information Systems and Science*. 2nd edition. West Sussex, England: John Wiley & Sons.

Worboys, M and Duckham, M. (2004). *GIS – A Computing Perspective*. 2nd edition. Boca Raton, FL: CRC Press.

CLASS POLICIES:

- Late submissions will result in a penalty on your grades except for any prudent and documented reasons. It will be 10% reduction of your grade per one day late, and you will not any grades after one week late. *Late submissions of discussion questions and in-class lab assignments are not accepted.*
- You should allot a reasonable amount of time for the workloads of this course outside of class every week. The CSU recommends that students should invest at least 3 hours out of class for each credit hour. That is, you will need at least 12 hours of work outside of class.
- Students should refer to the information from the Office of University Registrar (<http://www.csuohio.edu/enrollmentservices/registrar>) regarding administrative procedures related to drop, add, withdrawal, and incompletes.
- It is your responsibility to follow the University Policies such as Student Conduct Code and Academic Regulations and Procedures, which can be found at <http://www.csuohio.edu/studentlife> when you take this course.
- Educational access is the provision of classroom accommodations, auxiliary aids and services to ensure equal educational opportunities for all students regardless of their disability. Any student who feels he or she may need an accommodation based on the impact of a disability should contact the Office of Disability Services at (216) 687-2015. The Office is located in MC 147. Accommodations need to be requested in advance and will not be granted retroactively.

COURSE SCHEDULE

Note: ✓ **required reading**, ○ *optional reading*

Week 1 (8/25) – Introduction

Class topic:

- Course overview

Lab session:

- Lab logistics
- *ArcGIS refresher* (Learning ArcGIS Desktop: ESRI Virtual Campus Course, 8 modules)

Week 2 (9/1) – Conceptual foundation I

Class topic:

- Defining GIS
- Geographic problems & GIS

Readings:

- ✓ Fotheringham, A. S. and Wilson, J. P. (2008). Geographic information science: an introduction. In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 1-8.

- ✓ Longley, P. A. et al. (2005). Systems, science, and study (Chapter 1). *Geographic Information Systems and Science*, 2nd edition. West Sussex, England: John Wiley & Sons, pp. 3-33.
- ✓ Wright, D. J., Goodchild, M. F. and Proctor, J. D. (1997). GIS: Tool or Science? Demystifying the Persistent Ambiguity of GIS as "Tool" vs. "Science". *Annals of the Association of American Geographers*, 87 (2), 346-362.

Lab session:

- Geoprocessing in ArcGIS (Part I)

Week 3 (9/8) – Conceptual foundation II

Class topic:

- The nature of geographic data and knowledge
- Spatial concepts

Readings:

- ✓ Longley, P. A. et al. (2005). The nature of geographic data (Chapter 4). *Geographic Information Systems and Science*, 2nd edition. West Sussex, England: John Wiley & Sons, pp. 85-107.
- ✓ Worboys, M and Duckham, M. (2004). Fundamental spatial concepts (Chapter 3). *GIS – A Computing Perspective*, 2nd edition. Boca Raton, FL: CRC Press, pp. 83-132.
- ✓ Golledge, R.G. (2002). The nature of geographic knowledge. *Annals of the Association of American Geographers*, 92 (1), 1-14.

Lab session:

- Geoprocessing in ArcGIS (Part II)

>>> **Homework #1 assigned (by 9/22)**

Week 4 (9/15) – Models of geographic information

Class topic:

- Field-based model and object-based model
- Geographic representations

Readings:

- ✓ Worboys, M and Duckham, M. (2004). Models of geographic information (Chapter 4). *GIS – A Computing Perspective*, 2nd edition. Boca Raton, FL: CRC Press, pp. 133-165.
- ✓ Longley, P. A. et al. (2005). Representing geography (Chapter 3). *Geographic Information Systems and Science*, 2nd edition. West Sussex, England: John Wiley & Sons, pp. 63-83.
- ✓ Longley, P. A. et al. (2005). Geographic data modeling (Chapter 8). *Geographic Information Systems and Science*, 2nd edition. West Sussex, England: John Wiley & Sons, pp. 177-197.

Lab session:

- Creating, Editing, and Managing Geodatabases for ArcGIS Desktop [ESRI Virtual Campus Course]

Week 5 (9/22) – Databases and GIS

Class topic:

- Introduction to databases
- Relational databases

Readings:

- ✓ Worboys, M and Duckham, M. (2004). Fundamental database concepts (Chapter 2). *GIS – A Computing Perspective*, 2nd edition. Boca Raton, FL: CRC Press, pp. 133-165.

Lab session:

- SQL primer

>>> **Homework #1 due**

Week 6 (9/29) – Spatial databases

Class topic:

- Object-oriented databases
- Spatial operations and relations

Readings:

- ✓ Shekhar, S. and Vatsavai, R. R. (2008). Object-oriented database management systems (Chapter 7). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 111-143.
- Shekhar, S. and Chawla, S. (2003). Spatial query languages (Chapter 3). *Spatial Databases – A Tour*. Upper Saddle River, NJ: Prentice-Hall, pp. 52-82.

Lab session:

- Spatial SQL

>>> **Homework 2 assigned (by 10/13)**

Week 7 (10/6) – Introduction to spatial analysis

Class topic:

- GIS and spatial analysis
- Exploratory spatial data analysis (ESDA)

Readings:

- ✓ Fischer, M. M. (1999). Spatial analysis: retrospect and prospect. In Longley, P. A. et al. (Eds.), *Geographical Information Systems*, 2nd edition. New York, NY: John Wiley & Sons, pp. 283-292.
- ✓ Charlton, M. E. (2008). Quantitative methods and geographic information systems (Chapter 21). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 379-394.
- Anselin, L., Syabri, I, and Kho, Y. (2006). GeoDa: An introduction to spatial data analysis. *Geographical Analysis*, 38, 5-22.
- Jacquez, G. M. (2008). Spatial cluster analysis (Chapter 22). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 395-416.

- Cromley, E. K., & McLafferty, S. (2002). *GIS and Public Health*. New York: Guilford Press, pp. 130-157 (Chapter 5: Analyzing spatial clustering of health events).

Lab session:

- ESDA in ArcGIS

Week 8 (10/13) – Spatial statistical analysis using GIS

Class topic:

- Spatial statistics
- Spatial statistical methods in GIS applications

Readings:

- ✓ Getis, A. (1999). Spatial statistics. In Longley, P. A. et al. (Eds.) *Geographical Information Systems*, 2nd edition. New York, NY: John Wiley & Sons, pp. 239-251.
- ✓ Anselin, L. (2005). Spatial statistical modeling in a GIS environment. In Maguire, D. J., Batty, M., and Goodchild, M. F. (Eds.) *GIS, Spatial Analysis and Modeling*, Redlands, CA: ESRI Press, pp. 93-111.
- Goodchild, M. F., & Janelle, D. G. (Eds.). (2004). *Spatially Integrated Social Science*. New York: Oxford University Press. [Electronically accessible at <http://proxy.ulib.csuohio.edu:2050/login?url=http://site.ebrary.com/lib/clevelandstate/Doc?id=10085303>].
 - Ch. 6: Identifying ethnic neighborhoods with census data – Group concentration and spatial clustering (by Logan, J. R. and Zhang, W.)
 - Ch. 7: Spatial analysis of homicide with areal data (by Messner, S. F. and Anselin, L.)

Lab session:

- Spatial statistical analyses in ArcGIS

>>> **Homework #2 due**

*** **Take-home exam distributed (turn in by 6 p.m. October 20)** ***

Week 9 (10/20) – Service (market) area analysis

Class topic:

- GIS & service area analysis

Readings:

- ✓ Birkin, M. (2005). Retail and service location planning. In Maguire, D. J., Batty, M., and Goodchild, M. F. (Eds.) *GIS, Spatial Analysis and Modeling*, Redlands, CA: ESRI Press, pp. 221-244.
- ✓ Cromley, E. K., & McLafferty, S. (2002). *GIS and Public Health*. New York: Guilford Press, pp. 259-287 (Chapter 10: Locating health services).
- Church, R. L., & Murray, A. T. (2009). *Business Site Selection, Location Analysis, and GIS*. Hoboken, N.J: John Wiley & Sons.
- Harris, R., Sleight, P., & Webber, R. (2005). *Geodemographics, GIS, and Neighbourhood Targeting*. Chichester: Wiley.
- Longley, P. and Clarke, G. (1995). *GIS for Business and Service Planning*. New York, NY: Wiley.

Lab session:

- Determine primary market area (PMA) using ArcGIS

>>> **Homework #3 assigned* (by 11/3)**

Week 10 (10/27) – Proposal presentations

Class topic:

- Proposal presentations

Lab session:

- TBA

Week 11 (11/3) – Decision analysis and GIS

Class topic:

Readings:

- ✓ Hossain, M. S., Chowdhury, S. R., Das, N. G., Sharifuzzaman, S., & Sultana, A. (2009). Integration of GIS and multicriteria decision analysis for urban aquaculture development in Bangladesh. *Landscape and Urban Planning*, 90(3-4), 119-133.
- ✓ Chang, N., Chang, Y., & Chen, H. (2009). Fair fund distribution for a municipal incinerator using GIS-based fuzzy analytic hierarchy process. *Journal of Environmental Management*, 90(1), 441-454.
- ✓ Boroushaki, S., & Malczewski, J. (2008). Implementing an extension of the analytical hierarchy process using ordered weighted averaging operators with fuzzy quantifiers in ArcGIS. *Computers & Geosciences*, 34(4), 399-410.
- Chiueh, P., Lo, S., & Chang, C. (2008). A GIS-based system for allocating municipal solid waste incinerator compensatory fund. *Waste Management*, 28(12), 2690-2701.
- Store, R. (2009). Sustainable locating of different forest uses. *Land Use Policy*, 26(3), 610-618.

Lab session:

- A multi-criteria decision analysis using ArcGIS

>>> **Homework #3 due**

Week 12 (11/10) – Participatory GIS

Class topic:

- Public Participation GIS (PPGIS)
- Privacy and legal issues

Readings:

- ✓ Weiner, D. & Harris, T. M. (2008). Participatory geographic information systems (Chapter 26). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 466-480.
- ✓ Talen, E. (2000). Bottom-up GIS. A new tool for individual and group expression in participatory planning. *APA Journal*, 66: 279-94.
- ✓ Cho, G. C. H. (2008). Geographic information science, personal privacy, and the law (Chapter 29). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 519-539.

Lab session:

- Web GIS (I): creating web mapping services using open APIs (e.g., Google Maps, Google Earth, Yahoo map, ESRI Web Mapping APIs)

Week 13 (11/17) – Web GIS

Class topic:

- Open Source GIS
- Underlying technologies

Readings:

- ✓ Jones, C. B. and Purves, R. S. (2008). Web-based geographic information systems (Chapter 31). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 559-580.
- ✓ Kamadjeu, R. (2009). Tracking the polio virus down the Congo River: a case study on the use of Google Earth™ in public health planning and mapping. *International Journal of Health Geographics*, 8. doi: 10.1186/1476-072X-8-4.
- Hall, G. B. and Leahy, M. G. (2008). *Open Source Approaches in Spatial Data Handling*. Berlin: Springer. [Available from OhioLink: <http://rave.ohiolink.edu/ebooks/ebc/9783540748311>].

Lab session:

- Web GIS (II): Building a customized web mapping services using Open Source applications (i.e., Geoserver + OpenLayer)

>>> **Homework #4 assigned (by 12/1)**

Week 14 (11/24) – Sharing geographic information

Class topic:

- Spatial data infrastructure
- Standards/interoperability

Readings:

- ✓ Cowen, D. J. (2008). The availability of geographic data: the current technical and institutional environment (Chapter 1). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 11-34.
- ✓ Harvey, F. and Tulloch, D. (2006). Local-government data sharing: evaluating the foundations of spatial data infrastructures. *International Journal of Geographical Information Science*, 20 (7), 743-768.
- ✓ Maguire, D. J. and Longley, P. A. (2005). The emergence of geoportals and their role in spatial data infrastructures. *Computers, Environment and Urban Systems*, 29, 3-14.

Lab session:

- Creating and Maintaining Metadata Using ArcGIS Desktop [ESRI Virtual Campus Course]

Week 15 (12/1) – Future trends and challenges

Class topic:

- Emerging topics and future trends
- Challenges in GIS research

Readings:

- ✓ Goodchild, M. F. (2008). Geographic information science: the grand challenges (Chapter 33). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 596-608.
- ✓ Reuter, A. and Zipf, A. (2008). Geographic information science: where next? (Chapter 34). In Wilson, J. P. and Fotheringham, A. S. (Eds.), *The handbook of geographic information science*, Malden, MA: Blackwell Publishing, pp. 609-619.

Lab session:

- Final project week

>>> **Homework #4 due date**

Week 16 (12/8) – Final project presentations

***** Turn in your final term paper by 6 p.m. December 8 *****

This schedule may be changed with a prior announcement.