GEO 241: Geographic Information Systems I
Spring 2011-2012 | Department of Geography | DePaul University

Time: Mon/Wed 1:00-2:30 pm  
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

Robert Sameh (Lab Assistant)  
-Contact: robsameh@gmail.com

2. Course Description

GEO241 is an introductory-level GIS course. The course covers the fundamentals of GIS. Topics include GPS, remote sensing, data models (vector and raster), coordinate systems, and map design. Instruction is accomplished through lectures and hands-on computer lab exercises using ArcGIS 10. Prerequisite(s): LSP 120 (Mathematical and Technological Literacy) or HON 180 or an instructor’s consent. LSP Learning domain: Scientific Inquiry Non-Lab

3. Learning Goals

- Recognize the potential of GIS
- Understand the concept of data model (or database) in GIS
- Understand the concept of datum, map projection, and geospatial coordinate systems
- Comprehend the basic components and operations of Global Navigation Satellite Systems, such as Global Positioning System (GPS)
- Understand principles of remote sensing, including aerial photography and satellite remote sensing
- Understand the nature and design principles of cartographic maps

4. Learning Outcomes: At the completion of GEO 241, you should be able to

- Articulate the utility of GIS given an application area
- Assess strengths and weaknesses of data models representing geographic reality
- Use common geospatial coordinate systems appropriately, such as geographic (latitude and longitude), Universal Transverse Mercator and State Plane coordinates
- Collect earth coordinates using a GPS receiver while recognizing sources of positional errors
- Differentiate the several types of resolution that characterize remotely sensed imagery, including temporal, spectral, and spatial resolution
- Classify geospatial products in terms of types of data capture methods, and identify sources of uncertainty
- Read cartographic maps in an informed manner, including map scale, map projection, and cartographic abstraction
- Employ cartographic design principles to make maps suited to a given problem
- Critique the design of cartographic maps in light of cartographic rules, audience, and purpose
- Develop basic ArcGIS 10 skills, including exploring geographic data, working with attribute tables, and making cartographic maps.
5. Course Reading(s): Readings are available in pdf files on D2L > Content > Readings

6. Outlines of Topics & Tentative Schedules

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>In-class activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/26</td>
<td>Course overview</td>
<td></td>
</tr>
<tr>
<td>3/28</td>
<td>1. Introduction to GIS</td>
<td>Classify geographic problems</td>
</tr>
<tr>
<td>4/2</td>
<td>2. Survey of GIS</td>
<td>Watch GIS application video</td>
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<tr>
<td>4/4</td>
<td>3. Introduction to ArcGIS</td>
<td>Explore ArcGIS*</td>
</tr>
<tr>
<td>4/9</td>
<td>4. GIS data model</td>
<td>Explore geographic data*</td>
</tr>
<tr>
<td>4/11</td>
<td>5. Database concept</td>
<td>Work with attribute tables*</td>
</tr>
<tr>
<td>4/16</td>
<td>6. Datum and map projections</td>
<td>Classify map projections</td>
</tr>
<tr>
<td>4/18</td>
<td>7. Geospatial coordinate systems</td>
<td>Change coordinate systems*</td>
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<tr>
<td>4/23</td>
<td>Midterm</td>
<td></td>
</tr>
<tr>
<td>5/2</td>
<td>10. Map reading</td>
<td>Read cartographic maps</td>
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<tr>
<td>5/7</td>
<td>11. Map design</td>
<td>Make thematic maps*</td>
</tr>
<tr>
<td>5/23</td>
<td>12. Map critique</td>
<td>Critique maps</td>
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<tr>
<td>5/14</td>
<td>Project help</td>
<td>1. Normalizing a flat file*</td>
</tr>
<tr>
<td>5/16</td>
<td></td>
<td>2. Geocoding TRI data*</td>
</tr>
<tr>
<td>5/21</td>
<td></td>
<td>3. Making toxic maps*</td>
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<tr>
<td>5/23</td>
<td></td>
<td>4. Spatial analysis*</td>
</tr>
<tr>
<td>5/28</td>
<td></td>
<td>5. Census mapping* (optional)</td>
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<tr>
<td>5/30</td>
<td>Final</td>
<td></td>
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<tr>
<td>6/4</td>
<td>Project report by 2pm on D2L</td>
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* are lab activities for developing basic ArcGIS skills.

7. Grading Scheme

<table>
<thead>
<tr>
<th>Grading Breakdown</th>
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<tbody>
<tr>
<td>Participation</td>
<td>10%</td>
</tr>
<tr>
<td>10 Activities (each 3 pts)</td>
<td>30%</td>
</tr>
<tr>
<td>3 Homework (each 4 pts)</td>
<td>12%</td>
</tr>
<tr>
<td>Project report</td>
<td>18%</td>
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<tr>
<td>Exams (midterm 10%, final 20%)</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grading Scale</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
</tr>
<tr>
<td>A-</td>
<td>90-92.99%</td>
</tr>
<tr>
<td>B+</td>
<td>87-89.99%</td>
</tr>
<tr>
<td>B</td>
<td>83-86.99%</td>
</tr>
<tr>
<td>B-</td>
<td>80-82.99%</td>
</tr>
<tr>
<td>C</td>
<td>73-76.99%</td>
</tr>
<tr>
<td>C-</td>
<td>70-72.99%</td>
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<tr>
<td>D</td>
<td>60-69.99%</td>
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<tr>
<td>D+</td>
<td>50-59.99%</td>
</tr>
<tr>
<td>F</td>
<td>0-49.99%</td>
</tr>
</tbody>
</table>

**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.

Activities: These will be completed in class when instructors are present under most circumstances. If you can’t complete labs in class before due dates, you can finish them during lab hours with the help of a lab assistant or alone in GIS lab during open hours (see Section 9 for open hours). ArcGIS is additionally installed in SAC268 and Richardson Library. If you’d like to have ArcGIS installed in your personal computer, you can download a free trial of ArcGIS Desktop 10 at http://www.esri.com/software/arcgis/arcgis-for-desktop/free-trial.html.

Homework: Homework will be completed outside of the class individually.
• HW1 (GIS Case Studies): investigate an area of GIS application that interests you, and write summary/reflection report
• HW2 (GIS Data Models): compare and contrast vector and raster in encoding spatial aspects of the real world, and discuss utility and limitations of spatial data modeling
• HW3 (GIS Data Collection): classify USGS geospatial data products in terms of type of data capture methods, and identify sources of uncertainty

Project: Towards the end of quarter, you will be guided to do GIS project in class. The goal is to examine spatial variation of toxic chemicals released in your home county using GIS. At the end of the quarter, you should turn in a paper that summarizes spatial distribution of toxic emission in reference to maps you made, and describes processes you went through.

Exam: Midterm covers the first half. Final is a comprehensive exam. Both are closed-book written tests. Note that final will be held in the last day of the class, not during a final week.

Late Work Policy: Late work will be accepted with 25% of the total grade reduced for each day being late. For example, if you turn in activities or homework in four days, no points will be granted. Extensions, if needed, should be requested via an instructor’ consultation in a timely fashion, and can be granted at an instructor’ discretion.

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. Reading & Learning Objectives by Class

[1] Introduction to GIS

Read Longley Section 1.1, 1.2, and 1.5
- Describe distinguishing characteristics of geographic problems
- Distinguish data, information, and knowledge in the context of information system, and discuss role of GIS in transforming data into information
- Describe six component parts of GIS, and understand how they work together for addressing geographic problems

[2] Survey of GIS

Read Longley Section 1.4, 1.6, 2.1, and Table 2.1

- Describe history of GIS over the last five decades by dividing it into three eras, including major milestones
- Describe characteristics of GIS industry by dividing it into software, data, and service industry, and discuss trends in GIS industry
- Describe as many application areas of GIS as possible

[3] Introduction to ArcGIS

Read Longley Section 7.6 and What is ArcGIS Desktop.pdf on D2L

- Differentiate types of GIS software systems (e.g., desktop GIS, server GIS)
- Describe key functionality of ArcGIS Desktop
- Differentiate a suite of applications, product levels, and extensions of ArcGIS Desktop

[4] GIS Data Model (Data model representing spatial aspects of the reality)

Read Longley Section 3.6, and 8.2

- Describe how raster and vector data model encodes spatial aspects of the real world in a computer
- Describe characteristics and role of topological vector model
- Describe different methods of representing surface (such as elevation), including Triangulated Irregular Networks (TIN)

[5] Database Concept (Data model representing attribute aspects of the reality)

Read Longley Section 10.3, 10.1, 10.2, and 10.4

- Distinguish different field (column) data types, such as short, long, float, double, and string
- Apply Codd’s rules of normalization to entering and editing attribute data in tables
- Describe capabilities of database management systems (DBMS), and discuss advantages of storing data in DBMS over storing data in files

[6] Datum and Map Projection

Read Bolstad Chapter 3: 69-102
• Describe characteristics and role of several geometric approximations of the earth’s shape (or Earth model) such as geoids, ellipsoids, and spheres
• Describe characteristics of common horizontal datums, such as North American Datum of 1983 (NAD 83) or the World Geodetic System of 1984 (WGS 84), including Earth model and network of survey control points
• Explain the family of map projection (e.g., conic, cylindrical), and the property of map projection (e.g., equal area, conformal)


Read Bolstad Chapter 3:102-117

• Describe characteristics and appropriate uses of geographic (latitude and longitude) coordinates
• Describe characteristics and appropriate uses of Universal Transverse Mercator (UTM)
• Describe characteristics and appropriate uses of State Plane coordinates (SPC)


Read Longley Section 9.1 and Bolstad Chapter 5: 175-210

• Differentiate primary and secondary data capture methods
• Describe how the position of a GPS receiver is determined
• Describe sources of positional errors of GPS data
• Describe how the differential GPS improves positional accuracy


Read Bolstad Chapter 6: 211-257; Read Longley Section 9.2

• Explain electromagnetic spectrum
• Explain spectral signature
• Describe sources of geometric distortion in aerial images, and define orthoimagery
• Describe characteristics of two types of remotely sensed images, that is aerial images and satellite images
• Explain the difference between active and passive remote sensing, citing examples of each

[10] Map Reading

Read Kimerling 2005 and Monmonier 1991

• Differentiate different map types (e.g., reference vs. thematic map; choropleth map vs. isoline map)
• Read and convert map scale across different formats
• Identify visual variables used in cartographic maps

Read Slocum 2008 and Dent 1998

- Articulate appropriate uses of visual variables
- Explain why data normalization is necessary for choropleth mapping
- Articulate when to use different thematic map types
- Explain why visual hierarchy is important in map design, and describe how to achieve it

[12] Map Critique

Read Monmonier 2005

- Critique cartographic maps in terms of cartographic rules
- Critique cartographic maps in terms of intentions and audience

References


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/studentswithdisabilities). 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

**SAC 224 OPEN HOURS FOR GEO STUDENTS**

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
</tr>
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<tbody>
<tr>
<td>Mondays</td>
<td>8:00 - 9:30 AM &amp; 6:00 - 9:15 PM</td>
</tr>
<tr>
<td>Tuesdays</td>
<td>8:00 - 9:30 AM &amp; 4:20-9:15 PM</td>
</tr>
<tr>
<td>Wednesdays</td>
<td>8:00 - 9:30 AM &amp; 6:00 - 9:15 PM</td>
</tr>
<tr>
<td>Thursdays</td>
<td>8:00 - 9:30 AM &amp; 4:20 - 5:50 PM</td>
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<tr>
<td>Fridays</td>
<td>8:00 AM -5:00 PM</td>
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<tr>
<td>Saturday</td>
<td>1:00 - 4:00 PM</td>
</tr>
<tr>
<td>Sunday</td>
<td>1:00 - 4:00 PM</td>
</tr>
</tbody>
</table>

**Geospatial Industry and Geospatial Workforce**

The geospatial industry is defined as "an information technology field of practice that acquires, manages, interprets, integrates, displays, analyzes, or otherwise uses data focusing on the geographic, temporal, and spatial context" (Geospatial Workforce Development Center at the University of Southern Mississippi 2001). Geospatial workforce is in high demand according to the US Department of Labor at http://www.doleta.gov/BRG/Indprof/geospatial_profile.cfm

**GIS Certificate:** The Certificate Program in Geographic Information Systems (GIS) requires 20 hours of instruction. It provides sophisticated education in cartography/ GIS and proper training for employment in related industries and consulting. There are five required courses to complete the certificate:

- GIS I (GEO 241) – offered every quarter
- GIS II (GEO 242) – offered twice a year
- Remote Sensing (GEO 243) – offered twice a year
- GIS III (GEO 344) or Remote Sensing II (GEO 343) – offered once a year
- Research Techniques (GEO 391) – offered once a year (usually Winter)

Visit [http://las.depaul.edu/geography/Programs/CertificateInGIS/index.asp](http://las.depaul.edu/geography/Programs/CertificateInGIS/index.asp) for more info.
Appendix A. Department of Geography Learning Goals

GEO241 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. Learning Domain: Scientific Inquiry

Courses in the Scientific Inquiry domain are designed to provide students with an opportunity to learn the methods of modern science and its impact on the world around us. Courses are designed to help students develop a more complete perspective about science and the scientific process, including: an understanding of the major principles guiding modern scientific thought; a comprehension of the varying approaches and aspects of science; an appreciation of the connection among the sciences; the fundamental role of mathematics in practicing science; an awareness of the roles and limitations of theories and models in interpreting, understanding, and predicting natural phenomena; and a realization of how these theories and models change or are supplanted as our knowledge increases. Every course at DePaul must meet standards outlined by the Liberal Studies Council. Learning domain courses should demonstrate at least one learning outcome listed below
Learning Outcomes – relevant ones are highlighted
1. Students will understand the major principles guiding modern scientific thought. Students will demonstrate a mastery of the science content knowledge of their SID courses.
2. Students will know that science, technology, and math serve as mechanisms for inquiry into the nature of the universe. Students will:
   a. Identify questions that can be answered through scientific investigations
   b. Design and conduct a scientific investigation to test a scientific hypothesis
   c. Use appropriate tools and techniques to gather, analyze, and interpret data to support or refute a scientific hypothesis.
   d. Develop descriptions, explanations, predictions, and models using evidence.
   e. Describe relationships between evidence and explanations using critical and logical thinking.
   f. Recognize and analyze alternative explanations and predictions
   g. Communicate scientific procedures and explanations.
   h. Use mathematics in all aspects of scientific inquiry.
3. Students will understand and appreciate the interrelationships among science, technology and math. Students will:
   a. Use technology and mathematics to identify a problem or design a solution to a problem.
   b. Give examples of how science and technology inform and influence each other.
4. Students will understand and appreciate the role of science in society and in their lives. Students will:
   a. Provide examples of how science and technology impact our lives, and how social needs and concerns impact our development of technology and scientific investigation.
   b. Develop positive attitudes towards science, technology, and mathematics.
   c. Establish an ongoing experiential/service-learning interest in science, technology, and mathematics.
5. Students will understand the nature of science, technology, and mathematics. Students will:
   a. Provide examples of the abuse of science, including the representation of unfalsifiable claims as science and other forms of pseudoscience.
   b. Explain the strengths and limits of scientific inquiry.
   c. Explain the difference between evidence and inference, and the provisional nature of scientific explanations by providing examples of how our understanding of the workings of the world has changed in the past.
   d. Explain the difference between probability and certainty, and describe what is meant by uncertainty in the context of science, technology, and mathematics.

Writing Expectations: Writing is integral for communicating ideas and progress in science, mathematics and technology. The form of writing in these disciplines is different from most other fields and includes, for example, mathematical equations, computer code, figures and graphs, lab reports and journals. Courses in the SI domain must include a writing component where that component takes on the form appropriate for that course (e.g. lab reports, technical reports, etc.)