Course Description
GIS is an information system that specializes in capturing, managing, displaying, and analyzing geographically referenced data. GIS has a wide range of applications in disaster response, archeology, public health, crime analysis, market analysis, environmental modeling, hydrologic modeling, and much more. With advances in geotechnologies (which roughly includes GIS, remote sensing, and GPS) and information technology, a demand for geospatial workforce has been growing. 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. DePaul’s GIS certificate program provides training for geospatial workforce. For more information on DePaul’s GIS program, check out the website: [http://las.depaul.edu/geography/Programs/CertificateInGIS/index.asp](http://las.depaul.edu/geography/Programs/CertificateInGIS/index.asp).

GEO241, as a required course for GIS certificate, is an introductory-level course covering the fundamentals of GIS. The course consists of five units. Each unit covers (i) coordinate systems (Datum, map projection), (ii) data capture (GPS, remote sensing, etc.), (iii) data models (vector, raster, relational database), (iv) map design, and (vi) spatial analysis. Instruction is accomplished through lectures and hands-on computer lab exercises using ArcGIS 10.1. Prerequisite(s) of GEO241 is LSP 120 or HON 180 or MAT 130 or instructor’s permission.

Learning goals
- Recognize the potential of GIS in any application of your interest
- Understand how earth coordinate systems are defined, including datum and map projection
- Comprehend where data for GIS come from, and how those data are entered in computer databases
- Understand how data is structured to represent geography in the computer
- Learn how to design and make effective maps
- Learn basic techniques of spatial analysis, including buffering, overlay, and query

Learning Outcomes: At the completion of GEO 241, you should be able to
- 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, and import GPS data into GIS
- Differentiate types of resolution that characterize remotely sensed imagery
- Assess strengths and weaknesses of data models representing geography
- Employ cartographic design principles to make maps suited to a given problem
- Conduct suitability analysis using spatial analysis
- Develop basic ArcGIS skills, including geocoding, exploring geographic data, working with attribute tables, table join, making thematic maps, and conducting spatial analysis.

Outlines of Topics & Tentative Schedules*

<table>
<thead>
<tr>
<th>Wk.</th>
<th>Date</th>
<th>Topic</th>
<th>Read</th>
<th>Lab Activities</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/12</td>
<td>Course overview</td>
<td>Ch1</td>
<td>1. Introduction to ArcGIS</td>
<td></td>
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<tr>
<td></td>
<td>9/17</td>
<td>Introduction to GIS</td>
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<tr>
<td>2</td>
<td>9/19</td>
<td>Datum &amp; map projections</td>
<td>Ch2</td>
<td>2. Understand map projections</td>
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<td></td>
<td>9/24</td>
<td>Coordinate systems</td>
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<td>3. Change coordinate systems</td>
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<tr>
<td>3</td>
<td>9/26</td>
<td>Quiz1/GPS Remote sensing</td>
<td>Ch3</td>
<td>4. Collect data using a GPS receiver</td>
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<td></td>
<td>10/1</td>
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<td></td>
<td>5. Classify remotely sensed images</td>
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<td>4</td>
<td>10/3</td>
<td>Spatial data model</td>
<td>Ch5</td>
<td>6. Explore geographic data</td>
<td>1. Base mapping (due 10/4 Friday midnight)</td>
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<td></td>
<td>10/8</td>
<td>Relational database</td>
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<td>7. Work with attribute table</td>
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<td>5</td>
<td>10/10</td>
<td>Quiz2/Map reading</td>
<td>Ch10</td>
<td>8. Make thematic map I</td>
<td>2. POI mapping (due 10/11)</td>
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<td>10/15</td>
<td>Map design</td>
<td></td>
<td>9. Make thematic map II</td>
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<td>6</td>
<td>10/17</td>
<td>Spatial analysis</td>
<td>Ch6</td>
<td>10. Vector spatial analysis</td>
<td>3. Census mapping (due 10/18)</td>
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<td>10/22</td>
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<td>11. Raster spatial analysis</td>
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<td>7</td>
<td>10/24</td>
<td>Quiz3 Proposal due</td>
<td>Labs continued</td>
<td>4. Toxic mapping (due 10/25)</td>
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<td>10/29</td>
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<tr>
<td>8</td>
<td>10/31</td>
<td>Project</td>
<td></td>
<td>5. Suitability analysis (due 11/1)</td>
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<td></td>
<td>11/5</td>
<td>Project</td>
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<td>9</td>
<td>11/7</td>
<td>Project</td>
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<td>Take-home Exam (11/8)</td>
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<td>11/12</td>
<td>Project</td>
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<tr>
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<td>11/14</td>
<td>Presentation (if time allows)</td>
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<td>11/21</td>
<td>Project report due</td>
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*Schedules outlined above are subject to change depending on circumstances.

Grading Breakdown

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<thead>
<tr>
<th>Type</th>
<th>Breakdown</th>
<th>When</th>
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<tbody>
<tr>
<td>3 quizzes</td>
<td>12 %</td>
<td>In the class on week 3, 5, 7</td>
</tr>
<tr>
<td>11 activities</td>
<td>22 %</td>
<td>In the class on week 1-6</td>
</tr>
<tr>
<td>5 assignments</td>
<td>15 %</td>
<td>Due Week 4-8 Friday midnight on D2L</td>
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<tr>
<td>Exam (take-home)</td>
<td>20 %</td>
<td>Week 9 Friday (11/8): due midnight on D2L</td>
</tr>
<tr>
<td>Project</td>
<td>21 %</td>
<td>Week 11 Thursday (11/21): due midnight on D2L</td>
</tr>
<tr>
<td>Participation</td>
<td>10 %</td>
<td>Throughout the quarter</td>
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</table>

Grading Scale

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<tr>
<th>Grade</th>
<th>Range</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
<td>A+</td>
</tr>
<tr>
<td></td>
<td>87-89.99%</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>88-86.99%</td>
<td>A-</td>
</tr>
<tr>
<td>B</td>
<td>83-86.99%</td>
<td>B+</td>
</tr>
<tr>
<td></td>
<td>80-82.99%</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>79-76.99%</td>
<td>B-</td>
</tr>
<tr>
<td>C</td>
<td>76-72.99%</td>
<td>C+</td>
</tr>
<tr>
<td></td>
<td>71-69.99%</td>
<td>C</td>
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<tr>
<td></td>
<td>69-66.99%</td>
<td>C-</td>
</tr>
<tr>
<td>D</td>
<td>66-59.99%</td>
<td>D+</td>
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<tr>
<td></td>
<td>59-56.99%</td>
<td>D</td>
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<tr>
<td>F</td>
<td>0-56.99%</td>
<td>F</td>
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</table>

Quizzes: quizzes are to monitor your knowledge of GIS fundamentals. Quizzes will be held in week 3, 5, and 7. The quiz will cover materials from the previous week. For instance, a quiz on week 3 will cover contents of week 1 and 2. The format of quizzes will vary from true and false, multiple choice, short answer, term definition, and short essay. Quizzes will take 10-15 minutes. All are written tests; that is ArcGIS skills are not tested in quizzes.

Activities: activities are to help you practice concepts learned from the class, and learn basic ArcGIS skills. Activities can be done in the class when instructors are present. Although reasonable amount of time will be given to complete activities in the class, it is expected that you will complete remaining part of activities outside of the class in case you can’t complete activities in the class. If this happens to you, I recommend that

- Show up during **lab hours** which will be in GIS lab, and finish activities with the help of a lab assistant;
- Do it on your own in computer labs where ArcGIS is available, that is SAC224, SAC268, Daley 1327, computer labs in Richardson Library (JTR 100, JTR 2NW, JTR 2SE), and Loop Library (DPC 10012). Check [http://qrc.depaul.edu/hours.htm](http://qrc.depaul.edu/hours.htm) for open hours in GIS lab (SAC224) and SAC 268 before visit since these locations are often occupied by classes.
- Install a **60-day free trial of ArcGIS 10.1**, (not 10.2!) and work in your personal computer. No Mac support for free trial. Other options for installing ArcGIS for desktop in your computer include buying an ESRI Press book that comes with a 180-day evaluation copy or buying ArcGIS for Home Use for a $100 annual fee.

Each activity is due before the class **one week** after the activity is handed out in the class unless noted otherwise.

**Assignments:** five assignments will be given each week from week 2 to week 6. Assignments are to be done on your own outside of the class. Assignments will give another opportunity to practice GIS concepts and ArcGIS skills. **10 days** will be given students to complete each assignment. Each assignment is due Friday midnight one week after the assignment is handed out unless noted otherwise. For example, if the assignment is handed out on 9/24 (Tuesday), the assignment is due midnight on 10/4 (next week Friday).

- **#1 (base mapping):** make base maps showing different parts of the world. You should be able to choose appropriate coordinate systems for depicting different parts of the world.
- **#2 (POI mapping):** map POI (Point of Interest) using GPS and address geocoding. You should be able to collect POI data by GPS and address geocoding, and make a point symbol map.
- **#3 (census mapping):** download census data, and make a census map by joining table to geographic data. You should be able to perform table join properly.
- **#4 (toxic mapping):** download Toxic Release Inventory (TRI) sites, and make a toxic map by geocoding XY data. You should be able to justify choice of different parameters of cartographic design (such as choosing appropriate map projection, map symbol, map type, data representation, and so on).
- **#5 (suitability analysis):** identify or/and assess suitable sites for a new school considering multiple criteria. You should be able to conduct suitability analysis using buffering, overlay, and query in both vector and raster environment properly.

**Exam:** one comprehensive exam will be taken outside of the classroom during week 9. The exam will be handed out in the Thursday class on week 9 (so you can ask any questions in the class), and will be due on Friday midnight in the same week. The format of this exam varies short answers to discussion and application type of essay. **Plagiarism** in whatever the format or source may be, if detected, will automatically change your grade to zero.

**Project:** you should submit a one-page proposal of GIS project by week 7. The project should demonstrate that you can apply GIS knowledge and skills appropriately to the problem that you’re interested in exploring. Examples of GIS project in the previous quarter include mapping crime in Washington D.C., mapping food desert in Chicago south suburbs, mapping health indicators in US Counties, analyzing crop suitability in Africa, and mapping toxic chemicals from EPA Toxic Release Inventory sites. You should submit a project report by week 11. While it is not mandatory (mainly due to schedule conflict among working students), I highly recommend that you work as a small group of two persons for project.

**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.

**Late Work Policy:** Late work can be accepted with the reduction of 20% of the grade per day being late. For instance, if you turn in labs 5 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.

**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 Center for Students with Disabilities (CSD) (Phone 773/325-1677, TTY 773/325-7296, Fax 773/325-7396, http://studentaffairs.depaul.edu/csd/). 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 the CSD website.

**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

**GEO 241 Learning Objectives**

At the end of each module, you should be able to:

**Introduction to GIS**
- Get familiar with applications of GIS
- Describe how spatial data is different from aspatial data, and how spatial data is stored in GIS
- Define GIS in terms of components and functions, and identify distinguishing characteristics of GIS
- Discern the utility of GIS
- Get familiar with ArcGIS for Desktop

**Georeferencing: Datum and map projections**
- Describe what ellipsoid is, and what its intended use is
- Describe what datum and map projection is
- Explain patterns of distortion involved in map projections
- Describe family of map projections, that is cylindrical, azimuthal, and conic map projections
- Display different parts of the world using appropriate map projections in ArcGIS

**Georeferencing: Geospatial coordinate systems**
- Convert latitude and longitude coordinates in degree minute second to decimal degrees format
Differentiate geographic and projected coordinate system
Describe Universal Transverse Mercator
Describe State Plane Coordinate system
Geocode XY data

Data for GIS: In situ data collection
Describe what GPS is, and how GPS data is used in GIS
Describe how land surveying tools have evolved
Collect coordinates using a GPS receiver, and import GPS data into GIS for mapping

Data for GIS: Remote sensing data collection
Understand principles of remote sensing (RS)
Describe resolution of remote sensing—temporal, spatial, spectral, and radiometric
Discuss appropriate uses of different types of remote sensing—aerial photography, multispectral RS, hyperspectral RS, LiDAR RS, and RADAR RS

Data model: Spatial data model
Describe how vector data model represents spatial features in GIS
Describe how raster data model represents spatial features in GIS
Get familiar with commonly used spatial data format

Data model: Relational database
Describe how attribute data are stored in GIS
Add and calculate fields in the attribute table
Join table to spatial data
Perform attribute query (Selection by Attributes)

Cartography: Map reading
Get familiar with different map types, and discuss their appropriate uses
Identify visual aspects (variables) of map symbols, and discuss their appropriate uses
Read map scale in different formats appropriately
Describe data classification methods

Cartography: Map design
Choose map projection appropriately
Choose visual variables of map symbols appropriately
Decide on data representation appropriately
Choose map types appropriately
Arrange map elements appropriately

Spatial analysis: vector data analysis
Perform spatial query (Select by Location) on vector
Describe when and how to use buffering with vector data
Describe when and how to use overlay with vector data
Conduct suitability analysis using vector operations

Spatial analysis: raster data analysis
Create raster buffer
Describe when to use spatial interpolation
Describe how map algebra works
Conduct suitability analysis using raster operations
Appendix A. Department of Geography Learning Goals

Courses in the Department of Geography teach students—Goals relevant to GEO 241 are highlighted:

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. Liberal Studies 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 – outcomes relevant to GEO 241 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.)