GEO 241: Geographic Information Systems I (section 201)
Cross-listed with **PSC 201: Geographic Information Systems** (section 201)
December 2014|Department of Geography |DePaul University
LSP Learning Domain: Scientific Inquiry (SI) Non-lab

Course meets December 1, 2, 3, 4, 8, 9, 10, 11, 15 & 16 at 4-7:15 pm in SAC 224 (GIS Lab)

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Lab hours: **7:30-8:30 pm** in GIS lab after classes

Course Description

As things occur somewhere sometime, it is natural to look at and organize things through a spatial (and temporal) lens. **GIS**, computer-based systems for solving spatial problems, have been widely used in many applications, such as disaster response, public health, crime analysis, market analysis, archeology, environmental modeling, and much more. With advances in **geospatial technologies** (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.

GEO241, as a required course for **GIS certificate**, is an introductory-level course covering the fundamentals of GIS. Course contents are aligned with Core Geospatial Abilities and Knowledge in Geospatial Technology Competency Model (GTCM) adopted by US Department of Labor in 2011. Instruction is accomplished through lectures and hands-on computer lab exercises using ArcGIS 10.2. This course will provide foundation for GIS career if the goal is to obtain GIS certificate. The course, fulfilling LSP SI domain, will demonstrate how math, science, and technology are applied to represent geographic entities and solve geographic problems. Students will also get to reflect on how technology affects social practice. Prerequisite(s) of GEO241 is LSP 120 or HON 180 or MAT 130 or instructor's permission.

Course Topics: through this course you will learn

- What GIS is, and how GIS has been used in different areas of applications
- How coordinate systems for GIS are defined, including datum and map projections (**georeferencing**)
- Where data for GIS come from (or are created), and where to get those data (**data collection**)
- How data for GIS is structured and organized in a computer (**data model**)
- How to design and make effective maps (**cartography**)
- How to conduct basic spatial analysis, including buffering, overlay, and query (**spatial analysis**)

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

- Enumerate what specific functions you can perform with GIS in different application areas
- Use common geospatial coordinate systems appropriately, such as geographic (latitude and longitude) coordinate system (GCS), Universal Transverse Mercator (UTM) and State Plane Coordinate (SPC) System
- Collect location data using a GPS receiver, and import GPS data into GIS
- Describe how different types of resolution that characterize remote sensor data affect intended uses
- Assess strengths and weaknesses of data models representing geography
- Perform selection query and table join on attribute tables properly
- Employ principles of cartographic design to make maps suited to a given problem
- Conduct suitability analysis by applying buffer, overlay, and map algebra to spatial data
- Apply GIS appropriately to address a geographic problem/question that interests you
- Develop basic ArcGIS skills—namely geocoding, exploring geographic data, working with attribute tables, making thematic maps, and conducting spatial analysis.

Course Readings: John Jensen & Ryan Jensen, 2012, Introductory Geographic Information Systems, Pearson (ISBN: 978-0136147763)—required. The text is available at the LPC college bookstore.

Outlines of Topics & Tentative Schedules

Day	Date	Topic	Read	Lab Activities	Assignment due
1	12/1 Mon	Course overview Introduction to GIS	Ch1	1. Introduction to ArcGIS	
2	12/2 Tue	Datum & map projections Coordinate systems	Ch2	2. Understand map projections 3. Change coordinate systems	
3	12/3 Wed	**Quiz1**/GPS Remote sensing	Ch3	4. Collect data using a GPS receiver 5. Classify remotely sensed images	
4	12/4 Thurs	Spatial data model Relational database	Ch5	6. Explore geographic data 7. Work with attribute table	1. Base mapping
5	12/8 Mon	**Quiz2**/Map reading	Ch10	8. Make thematic map I	2. Data for project
6	12/9 Tue	Map design	Ch6	9. Make thematic map II	3. Census mapping
7	12/10 Wed	Vector spatial analysis	Ch6	10. Vector suitability analysis	**Proposal**
8	12/11 Thurs	Raster spatial analysis Work on project		11. Raster suitability analysis	4. Toxic mapping
9	12/15 Mon	**Quiz3** Work on project			
10	12/16 Tue	**Presentation**			

Grading Breakdown

Components	Breakdown (/100 pts.)	Due
Participation	10 points	Throughout the quarter
11 **activities**	22 points	Each 2 points; before the next class after lab activities are handed out
3 **quizzes**	18 points	Each 6 points; in the class on day 3, 5, 9
4 **assignments**	16 points	Each 4 points; day 4-7 by 11:59 pm
Project (consists of four milestones)	34 points	**Proposal** (4 pts.) on day 7 (12/10) by 11:59 pm **Presentation** (4 pts.) on day 10 (12/16) before the class **Map of the Month** (6 pts.) on 12/17 on D2L by 11:59 pm **Report** (20 pts.) on 12/19 on D2L by 11:59 pm

Participation: you are expected to participate in the class discussion actively. Review questions will be posted before the class to facilitate participation and guide a focused reading. Many questions for participation in the class will come from those review questions. The score for participation will be assigned according to the following criteria:

- 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 and out of class, and stays on task in class-time activities.
- B (7-8) = Student participates as above, 75% of the time.
- C (6-7) = Student does not volunteer comments; responses demonstrate vague familiarity with course readings. Student is a passive participant in and out of class, and/or does not stay on task during class-time activities.
- D (5-6) = 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: learn GIS by doing. Activities are to help you make sense of concepts covered in readings/lectures. You will also learn basic ArcGIS skills through activities. You need to submit typed-in answers to few questions in those activities. You will do activities in the class when instructors are present. Activities are due before the next class for activities that are handed out in the previous class. For example, Activity 1 (handed out on 12/1) is due before the 12/2 class. Activity 6, 7 (handed out on 12/4) is due before the 12/8 (Monday) class. Although reasonable amount of time is given to complete activities in the class, it is expected that you will complete remaining part of activities outside of the class if you can't complete activities in the class. In that case, I recommend that

- Get a help from a TA to complete activities during lab hours held in GIS lab after classes;
- 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 the GIS lab door or http://qrc.depaul.edu/hours.htm for open hours in SAC224 and SAC 268 before visit since these locations are often occupied by classes.
- Install a 60-day free trial of ArcGIS 10.2.2, and work in your personal computer. 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.

Quizzes: check your knowledge of GIS fundamentals. The quiz is non-cumulative, closed-book. The format of quizzes is fill the blank, true and false, multiple choices, and short answers/essays. All are written tests; no ArcGIS skills are tested.

Assignments: solidify GIS concepts and ArcGIS skills by applying them to a new problem set. Assignments are to be done on your own outside of the class. You can get a help from instructors.

- #1 (point mapping): make a point map showing location of geographic features by geocoding XY data; to assess whether you can choose appropriate geodetic datum and map projections for a given geographic area of interest.
- #2 (data review): review data necessary to answer a geographic question that you would like to address for a potential GIS project; test whether you can find data appropriate for a GIS project and assess its fitness for use.
- #3 (census mapping): make a thematic map by joining attribute data (table) to census geography; test whether you understand key concepts of relational database and perform table join.
- #4 (toxic mapping): make a thematic map that visualizes amount of toxic chemicals released from the EPA's Toxic Release Inventory; check whether you can apply principles of cartographic design to map-making properly.

Project: propose and conduct a GIS project that demonstrates comprehensive use of GIS knowledge (i.e., drawing on at least two knowledge areas including data collection, data model, cartography, and spatial analysis) using empirical data to address an issue that interests you. Project can be proposed and conducted by a group.

GIS projects from the previous quarters include (a) mapping crime in Chicago, food deserts in Northwestern Indiana, and health indicators by US Counties; (b) analyzing whether cancers are more prevalent near hazardous waste sites, how income affects policing and crime, how Chicago Public School closings are related to income and race; and (c) identifying suitable sites for crop production in Africa, desirable Canadian Provinces; suitable hospital locations for HIV care in South Africa, and potential nesting sites for red-headed Woodpeckers in IL.

Project consists of the following four milestones whose guidelines are posted on D2L:

- Proposal: discuss what you would like to accomplish through the project, and identify what data and GIS operations you are going to use
- Presentation: present what you have done to address a problem stated above and what you found out
- Map of the Month (MOM): submit a map picked from your project, and discuss findings from the map; will be published as part of the department's MOM if your submission is accepted by the MOM selection committee
- Report: write a three-page (with single-spacing) paper that describes aim, methods, and results of your project

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 quiz 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.

Grading Scale							
A	= 93-100%	B+	= 87-89.99%	C+	=77-79.99%	D+	=60-69.99%
A-	= 90-92.99%	B	= 83-86.99%	C	=73-76.99%	D	=50-59.99%
		B-	= 80-82.99%	C-	=70-72.99%	F	=0-49.99%

Class schedule in a monthly calendar

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
- Get familiar with user interface and basic functionality of ArcGIS for Desktop

Georeferencing: Datum and map projections
- Describe what datum is
- Describe what map projection is
- Explain patterns of distortion involved in map projections
- Display different parts of the world using appropriate map projections in ArcGIS

Georeferencing: Geospatial coordinate systems
- Differentiate between geographic and projected coordinate systems
- Describe Universal Transverse Mercator
- Describe State Plane Coordinate system
- Geocode XY data

Data for GIS: In situ data collection
- List different methods through which geographic data is created
- Describe what GPS is, and how GPS data is used in GIS
- Describe how land surveying methods have evolved
- Collect coordinates using a GPS receiver, and import GPS data into GIS for mapping

Data for GIS: Remote sensing data collection
- Understand how remote sensing (RS) works
- Describe different aspects of resolution of RS, including temporal, spatial, spectral, and radiometric
- Discuss appropriate uses of different types of RS, including 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, including topology and georelational model
- Describe how raster data model represents spatial features in GIS, including spatial resolution, and how attributes are stored
- 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 using appropriate field data types
- 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 different data classification methods

Cartography: Map design

- Choose visual variables of map symbols appropriately
- Decide on data representation appropriately
- Choose map types appropriately
- Describe what visual hierarchy is, and arrange map elements by promoting visual hierarchy

Spatial analysis: vector data analysis

- Perform spatial query (Select by Location) on vector data
- 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, and describe how Inverse Distance Weighting works
- Describe different types of map algebra, and when to use them
- 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.)