GEO 242 (Geographic Information Systems II: Community GIS)

Autumn Quarter 2017 | Department of Geography | DePaul University

We meet on Tue/Thurs 4:20-5:50 pm at SAC 224 (SAC GIS Lab)

1. Course Description: GEO 242 is an intermediate-level GIS course. Students will work together as a group to conduct GIS project for community-based organizations (CBO) in Chicagoland following best practices of project management. GEO 242 focuses on understanding how GIS is used in organizations, and developing geographic database. Major topics include GIS needs assessment, spatial database design, data collection, geospatial data quality, and spatial analysis. The class is conducted through lectures, group work on project, and hands-on lab activities using ArcGIS for Desktop 10.4. Contents are aligned with Geospatial Technology Competency Model. Prerequisite is GEO141 or instructor's consent.

2. Instructors' Contact and Office/Lab hours

	Instructor	Teaching Assistant	GIS Coordinator
Name	Sungsoon (Julie) Hwang	Alex Temes	Cassandra Follett
Contact	shwang9@depaul.edu (773) 325-8668	ajtemes7@gmail.com	CFOLLETT@depaul.edu (773) 325-3267
Where	990 W Fullerton, 3133	TBA	990 W Fullerton, 3134
When	T, W, TH 2-3 pm or by appointment	TBA	when technical issues arise in Geog GIS Lab

3. Course Topics: through GEO 242 you will learn

- What are best practices of conducting and managing a GIS project?
- How to design database given user requirements?
- What processes are involved in developing database (entering data in GIS)?
- What is data quality, and how is data quality assessed?
- What are some useful techniques of spatial analysis, and how do they work?

4. Learning Goals

- Discern the interplay between GIS and organization by observing how geographic information needs arise in organizational contexts, and helping community organization to meet geographic information needs using GIS tools
- Get versed in constructs of database design for GIS, including entity-relationship modeling, relational schema, and geodatabase
- Grasp GIS data collection processes including data editing (e.g., attribute data import, geocoding), primary data capture (e.g., GPS), and secondary data capture (e.g., digitizing, georegistering unreferenced images) by developing GIS database on your own
- Understand elements related to data quality, including accuracy, completeness, and consistency
- Comprehend how methods of spatial analysis—including overlay, proximity analysis, density mapping, spatial interpolation, and map algebra—work, and when to use them

5. Readings: There is no required text to buy. Readings will be provided on D2L.

6. Learning outcomes— After completing requirements of GEO 242, you should be able to

- Assess geographic information needs, and design information products related to GIS given an organizational context
- Design database using entity-relationship modeling techniques linked to the relational model
- Develop geodatabase by applying various data collection techniques, including GPS data import, heads-up digitizing, coordinate transformation, geocoding, and topology validation
- Assess the fitness for use of data with respect to components of spatial data quality, including calculating measures of accuracy
- Conduct spatial analyses appropriate for a given problem in both vector and raster environments

7. Course outlines and tentative schedules

Wk	Date	Topic	In-class activities/group exercises	Project milestones
1	09.07	Course overview		
	09.12	1. Project management	**5p CBO rep.'s talk**, 1. write SOW	
2	09.14	2. GIS I recap	2. Map race and crime in Chicago	
	09.19	3. Database design – conceptual	3. From user requirements to ER diagram	
3	09.21		*Work on P1(Needs Assessment)*	[09.25] P1
	09.26	4. Database design - logical	4. From ER diagram to database schema	
4	09.28	5. Data editing - tabular	5. From flat files to geodatabase tables	
	10.03	6. Data editing - spatial	6. From shapefiles to gdb feature classes	
5	10.05	**Quiz 1**	**4:40p CBO rep.'s visit (TBD)**, *work on P2*	[10.09] P2
	10.10	7. Data capture - primary	7. Collect location data with GPS	
6	10.12	8. Data capture - secondary	8. Georegister unreferenced images	
	10.17	9. Data quality	9. Assess data quality	
7	10.19		*Work on P3 (Data Acquisition/Quality)*	[10.23] P3
	10.24	10. Spatial analysis – vector	10. Make spatially aggregate maps	
8	10.26	**Quiz 2** 11. Spatial analysis - raster	11. Apply algebraic operations on raster	
	10.31	12. Publish maps	12. Make a web map application	
9	11.02		*Work on P4 (Data Viz. & Analysis)*	[11.06] P4
	11.07		*Work on project*	
10	11.09	**Quiz 3** (unit 9-12)	*Work on project*	
	11.14		*Work on P5 (Presentation)*	
11	11.16	**Presentation**	**2:30p CBO rep. are invited**	[11.16] P5 & P6

8. Grading Scheme

Components	Breakdown (/100 points)	Notes
Participation	12	Attendance, class participation, and group discussion.
Group exercises	24	12 exercises. Each is worth 2 points.
Quiz	18	3 quizzes. Each is worth 6 points.
Group project	40	Consists of six project milestones (P1-P5 4 points, P6 20 points).
Peer review	6	Based on evaluation form filled out by peers in your project group

Participation: assigned according to the criteria below

- 11-12 = 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.
- 9-10 = Student participates as above, 75% of the time.
- 8-9 = 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.
- 6-7 = Student never volunteers, cannot respond to direct questions, keeps silent during class discussions and is unable to summarize readings if asked.
- 0-5 = Student misses many class sessions and/or sits silently in classes when present, or is disruptive and non-participatory in the classroom.

To participate actively, complete assigned readings for each unit and be prepared to discuss questions (or learning objectives) posted below in Detailed Plan of the Class before the class.

Exercises: Most of exercises focus on learning how to use ArcGIS. Submit answers to questions while performing GIS tasks. You can work on performing GIS tasks alone, but all exercises (answers to questions) should be submitted as a group work after discussion. Unless noted otherwise, exercises are due one week after the handout for an exercise is distributed. Exercises will be completed in class when instructors are present under most circumstances. Although reasonable amount of time is given to complete exercises 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 you get help from instructors to complete activities during office hours well before the deadline of exercises as you might encounter technical issues that you may not be able to troubleshoot on your own.

Quizzes: Three quizzes will be given out as scheduled. Quiz 1 covers units 1 - 4, Quiz 2 covers units 5 - 8, and Quiz 3 covers units 9 - 12. Each quiz is a closed-book test. Quiz questions come from readings, lecture notes, and lab exercises. You are not tested for ArcGIS skills by quizzes.

Project: A group of three persons will work together throughout the quarter in and outside of the classroom to achieve goals that groups set out in conjunction with CBOs that groups work for. Project is broken down to the following milestones:

Milestones	Points	Description
P1 (needs assessment)	4	Assess geographic information needs by defining goal, objectives, and information products
P2 (system requirements)	4	Specify data requirements and processing requirements
P3 (data acquisition/quality)	4	Describe data acquired or created, and assess data quality
P4 (data visualization/analysis)	4	Lay out the plan for data analysis and map design
P5 (presentation)	4	Present results to CBO reps; submit a presentation file
P6 (final report)	20	Final report consists of introduction, P1, P2, P3, P4, results and conclusion. Incorporate any feedback into a final report; Submit a document file and source/output data

Grading scale: A = 93-100%; A- = 90-92.99%; B+ = 87-89.99%; 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%

Late Work Policy: Late work will NOT be accepted. Extensions can be requested if needed, but will be only granted under understandable circumstances (e.g., clients did not provide data in time; you had to be in a funeral).

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.

9. Detailed Plan of the Class: readings, and learning objectives

W1 [9/12] Unit 1. Why do projects require project management?

Read Verzuh on project management: 13-24, 6-9, 60-67 (D2L > Content > Readings)

- Gallery of previous GIS II (GIS for community development) projects
- What is project, and how is project different from ongoing operations?
- What does a project manager do at different stages of project?
- Why does a project fail (what are key factors of successful projects)?
- Why write a statement of work (SOW), and what should be included in SOW?

Review P1: Needs Assessment (due 9/25)
Project sponsors will give a talk on their organizations and projects they have in mind
Ex 1: form a (tentative) group and write a SOW

W2 [9/14] Unit 2. GIS I recap

No lecture
Ex 2: map race and income in Chicago
As a group of three, design and create information product(s) that help examine the spatial distribution of race and crime, and the association between race and crime in Chicago using appropriate GIS techniques. After the completion of tasks, the following will be discussed:

- How are requirements of table join, and how is table join performed?
- How is XY data turned to geospatial data for mapping?
- What datum and map projections are appropriate for displaying the area of interest?
- What constitutes a well-designed map, and what are principles of cartographic design?
- What other issues occurred in the process, and what are ways to troubleshoot them if any?

[9/19] Unit 3. Database design – conceptual modeling

Read Shekhar on database design: 34-37 (on D2L)

- What are three steps (or levels) of database design, and how does each level differ?
- How is the world viewed through a lens of the Entity-Relationship (ER) model?
- How do you determine three kinds of relationships (1:1, 1:M, M:N) in the ER model?
- How does the ER diagram graphically represent the mini-world?

Ex 3: from user requirements to ER diagram (ERD)
Form a group (which is final) for project. Given user requirements (what a project client wants), come up with an information product (eg. what maps to make to meet those requirements?). Then draw the ER diagram based on the user requirements and information product.

W3 [9/21] Work on P1: needs assessment
[9/25] Submit P1 on D2L

[9/26] Unit 4. Database design – logical modeling

Read Shekhar on database design 37-41

- How does the relational model represent and organize data?
- What is entity integrity constraint and referential integrity constraint, respectively?
- How is the ER model mapped into the relational model?

Ex 4: from ERD to relational database schema
Building on Ex 3, conduct logical database design based on user requirements and information product by mapping the ERD into the relational database schema

W4 [9/28] Unit 5. Data editing – tabular

Read the ArcGIS help on What is a geodatabase? to Table basics

- What is a geodatabase? (visit TIGER/Line website > geodatabase)
- What are three fundamental datasets in the geodatabase?
- How are attribute data structured in a geodatabase?
- What are attribute domains and relationship classes used for?

Ex 5: from flat files to geodatabase tables (linking TRI data to zipcode boundary data)

- ✓ Normalize (format) flat files to make them compatible with geodatabase tables
- ✓ Work with column (field) name, alias, and type for geodatabase tables
- ✓ Add attribute domains and relationships (extended capabilities of geodatabase tables)
- ✓ Use VB functions in a field calculator

[10/3] Unit 6. Data editing – spatial

Read ArcGIS help on Feature class basics to Types of geodatabases, and Goldberg on geocoding (on D2L)

- How are geospatial data structured in a geodatabase?
- What are subtypes and topology used for?
- What are three types of geodatabases?
- How does geocoding work, and what are limitations of the current geocoding algorithm?

Ex 6: from shapefiles/tables to geodatabase feature classes

- ✓ Create a feature class by digitizing features on a basemap (georeferenced map images)
- ✓ Add subtypes and topology to a feature class
- ✓ Use annotation for flexible labeling
- ✓ Geocode street addresses in batch from scratch (by creating an address locator based on reference data acquired)

W5 [10/5] Quiz 1 (covers unit 1 to 4). Check in with CBO reps. Work on P2: Systems requirements
[10/9] Submit P2 on D2L

[10/10] Unit 7. Data capture – primary

Read Longley: 229-241 (data collection) (on D2L)

- Distinguish different ways to enter data into GIS database
- What are three key aspects of resolution for remotely sensed image?
- What techniques belong to primary data capture methods?
- What techniques belong to secondary data capture methods?

Ex 7: collect location data with GPS (LPC tree/green space mapping)

- ✓ Collect XY coordinates using a GPS (primary vector)
- ✓ Extract vegetation from NLCD data
- ✓ Join a spreadsheet (with attributes like tree type, DBH) to geospatial data for thematic mapping

W6 [10/12] Unit 8. Data capture – secondary

Read Shellito chapter 3 (Getting your data to match the map) on D2L

- How can you align different geospatial datasets to work together?
- How can data with unknown coordinate system be georeferenced?
- How is data transformed to a georeferenced format?

Ex 8: georegister scanned images (putting an ungeoreferenced scanned map on GIS)

- ✓ Perform coordinate transformation to georeference images

[10/17] Unit 9. Data quality

Read Veregin (Data quality parameters) on D2L

- Differentiate components of data quality – accuracy, consistency, and completeness
- How does resolution affect fitness for use of data?
- What is root mean square error, and what is it used for in assessing data quality?
- What is error (confusion) matrix, and what is it used for in assessing data quality?

Ex 9: assess data quality

- ✓ Manually inspect to determine how complete and inaccurate data is
- ✓ Measure positional errors (or numeric attribute errors) using RMSE
- ✓ Measure categorical attribute errors using error matrix

W7 [10/19] Work on P3: Data Acquisition
[10/23] Submit P3

[10/24] Unit 10. Spatial analysis – vector

Read TBA

- How does spatial join work, and when to use it?
- How does spatial apportionment work, and when to use it?
- What techniques can be used to perform proximity analysis?
- How can be a heat map (density mapping) created?

Ex 10: perform spatial analysis on vector data (making spatially aggregate maps)

- ✓ Perform spatial join (point in polygon)
- ✓ Perform spatial apportionment (polygon overlay)
- ✓ Conduct proximity analysis (Thiessen polygon, near)
- ✓ Conduct kernel density estimation

W8 [10/26] Unit 11. Spatial analysis – raster

Read TBA

Quiz 2 (covers units 5 to 8)

- What is spatial interpolation used for, and how does inverse distance weighting work?
- What is map algebra, and how can map algebra be classified?
- What is zonal statistics used for?

Ex 11: perform spatial analysis on raster data (applying algebraic operations on raster data)

- ✓ Perform spatial interpolation
- ✓ Use map algebra (raster calculator) to perform algebraic operations applied to raster layers
- ✓ Use zonal statistics

[10/31] Unit 12. Publish maps

Read Fu chapter 1 (Start with the cloud: build web apps using ArcGIS Online) on D2L

- What is web GIS?
- Why web GIS?
- How are web GIS applications built?

Ex 12: make a web map application

- ✓ Use ArcGIS Online to create a web app using a template
- ✓ Use Google Map (kml)
- ✓ Use QGIS Cloud

W9 [11/2] work on P4: data visualization & analysis
[11/6] submit P4
[11/7] work on project (P5: presentation, P6: final report)

W10 [11/9] **Quiz 3** (covers units 9-12). Work on project
[11/14] work on project (P5, P6)

W11 [11/16] 2:30 pm Presentation. Submit P5, P6

References

- Goldberg, W, and Knoblock. 2007. From texts to geographic coordinates: the current state of geocoding. URISA Journal 19(1): 33-46
- Fu, P. 2015. Getting to Know Web GIS. ESRI Press
- Longley et. al. 2010. Chapter 9 (Data collection) of "Geographic Information Systems and Science". 3rd ed. Wiley.

- Shekhar and Chawla. 2003. Chapter 2 (Spatial concepts and data models) of "Spatial Database: A Tour". Prentice Hall
- Shellito, B. 2015. Introduction to Geospatial Technologies. W. H. Freeman
- Veregin. 2005. Chapter 12 Data quality parameters in Eds (Longley et al). Geographical Information Systems: Principles, Techniques, Management and Applications. Wiley: 177-189
- Verzuh. 2008 The Fast Forward MBA in Project Management. Wiley

10. Access to ArcGIS

Labs with ArcGIS for Desktop

- SAC GIS lab (SAC 224), SAC 268
- Geography GIS lab (990 W Fullerton, Room# 3135)
- Richardson Library, Loop Library, Daley 1327

GIS lab open hours

- Geography GIS Lab (990 W Fullerton, Room# 3135): https://las.depaul.edu/academics/geography/geographic-information-systems-certificate/Pages/gis-lab.aspx or the lab door.
- SAC GIS lab (SAC 224): http://qrc.depaul.edu/hours.htm or the lab door.

Options for installing ArcGIS in your computer that runs on Windows (Mac is not supported for ArcGIS)

- Purchase a 1 year ArcGIS for Desktop Advanced for $ 100 with free ArcGIS online subscription at http://www.esri.com/software/arcgis/arcgis-for-home
- Buy one of ESRI Press books that come with a 180 day evaluation copy

To access ArcGIS in both PC and Mac remotely: go to DePaul Virtual Lab http://vlab.depaul.edu after week 1. Quality of user experiences vary by internet speed. At least 8 Mbps is recommended.

11. Miscellaneous

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 University's Center for Students with Disabilities (CSD) (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

12. Department of Geography Learning Goals—GEO 242 addresses 1), 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.