Introduction to Geographic Information Systems (GIS)

PLA 4577 Section 2 | Time: Tue 7-9pm / Thur 7-9pm Location: 200 Fayerweather North

Instructor: Jeremy White (jeremy.white@columbia.edu) | Office hours: Tue 9-10pm by request, or Google Hangout

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Syllabus : Fall 2016

Contents

1. Course Overview

Description

Geographic Information Systems (GIS) are tools for managing, describing, analyzing, and presenting information about the relationships between where features are (location, size and shape) and what they are like (descriptive information known as attribute data). Because its techniques allow one to represent social and environmental data as a map, GIS has become an important tool across a variety of fields including planning, architecture, engineering, public health, environmental science, epidemiology, and business. Further, GIS has become an important political instrument allowing communities and regions to (geo)graphically tell their stories.

GIS is a powerful tool, and this course is meant to introduce students to the basics. Because GIS can be applied to many research fields, this class is meant to give students an understanding of its possibilities along with the capabilities to begin engaging those possibilities.

The class will focus on teaching through practical example. Course exercises are based upon a relationship with the Bronx River Alliance, a local advocacy group for the Bronx River. Exercises will focus on the Bronx River Alliance's real-world needs in order to give students a better understanding of how GIS is applied to planning situations.

Roughly speaking, the course is organized in two parts. The first half of the course will focus on the basics by leading the students through skills-based GIS exercises. The second half of the course will be focused on individual student projects for which each student will be required to find data and design the methods of analysis to be used based on the techniques learned in the course.

Objectives

The course seeks to provide students with a basic level of familiarity with several aspects of Geographic Information Systems and Geographic Information Science, such that the range of possibilities for GIS-based work is understood and an adequate foundation for engaging those possibilities is laid. Thus, the objectives for the course are:

- Providing an understanding of basic skills necessary to work with GIS, predominantly using ESRI's ArcGIS software
- Introducing students to software and techniques beyond ESRI products
- Teaching spatial data visualization techniques along with introductory knowledge of effective cartography and additional software for the production of maps and other information graphics
- Teaching skills needed to develop and execute a project requiring GIS as a management, analytical, and/or visualization tool
- Identifying and accessing publicly available data sets
- Teaching the skills necessary to create GIS data through a variety of methods including those offered by global positioning system (GPS) technologies
- Providing an introductory understanding of the ethical questions surrounding data creation, analysis, and representation

2. **Class Format**

Standard Class Information

The class will meet in 200 Fayerweather on Tuesday 7-9pm and Thursday 7-9pm. Barring any technical difficulties, class will begin promptly with a marginal amount of time built into the beginning of every class for students to download the requisite files from Dropbox onto their local machines and/or external hard drives.

Standard Method of Instruction

The course will meet twice per week unless otherwise specified. While there are exceptions to this pattern, generally speaking, Tuesdays will consist of a lecture, class discussion and lab time to begin in-class exercises. Thursdays will usually be reserved as a lab session, during which students will have the opportunity to work through assignments with faculty guidance.

Guest Lectures

The course will feature a two guest lecturers. The GIS faculty have invited GIS professionals to discuss their work and experience so as to offer students descriptions of GIS use and application beyond the academic context.

3. **Evaluation & Grading**

Class participation, Readings & Discussion: 5% of total grade

There is a considerable amount of reading available on GIS-related topics. Especially at the introductory level, an understanding of the science, theory, and application of GIS is extremely important. Care has been taken to include necessary readings within this course with an understanding that the assignments themselves can overwhelm a student's schedule before the time necessary for readings is taken into account. Therefore, while the suggested reading list is lengthy, the required readings are minimal. Students are expected to complete required readings before class in order to participate fully in class discussion. For full participation points, a student should come to class prepared with questions and comments on weekly required readings and contribute to general class discussions. In the syllabus, readings are listed as:

- Required: for discussion – students should come to class prepared to discuss
- Required – students are required to read as reading will assist in learning/exercise completion
- Reference – optional readings/materials that provide additional information/detail.

In-class exercises: 0% of total grade

Because GIS is rooted in computer-based analysis, its adequate teaching and learning requires regularly completed exercises. Successful completion of the course requires that students stay with the schedule, completing exercises in a timely manner, such that skills learned early can be built upon later in the semester. Each week includes ungraded in-class exercises. The results of these exercises are not required to be turned in at the completion of class but do serve as the basis for the graded homework assignments.

Homework Assignments: 35% of total grade (5% each)

Most weeks include take-home exercise assignments. While some weeks these graded exercises may be completed during the lab session, the assignments are expected to be completed outside class when necessary. There are a total of eight (8) homework assignments. You are required to complete seven (7) of those assignments. Rather than accept late exercises, the GIS faculty allow students to skip the submission of one assignment with the expectation that the skills are learned even if the finished assignment is not turned in. If all eight are submitted, then the lowest grade will be dropped and not calculated with the final grade.

Problem Set: 15% of total grade

One assigned problem set will be given mid-semester. It is lengthier and slightly more complex than the homework assignments in that it requires students to apply a combination of skills learned up to that point

without the benefit of step-by-step tutorial instruction. The problem set will include questions requiring calculations and numeric responses, analysis with graphic responses (maps, tables, graphs, etc), and written responses on uses of GIS.

Case Study Reading Response: 10% of total grade

One reading response paper will be assigned at mid-semester. It is a short paper and presentation assignment requiring students to find, read, and comment on an example of published research that uses spatial analysis and/or specific GIS techniques.

Final Project: 30% of total grade

Students are expected to design, research, and complete a final project by the end of the semester. The project is required to be a specific research question answered or explored using GIS. Several deliverables at different times will be assigned to aid students in the completion of the project, and class time toward the end of the semester will be devoted to individual work with faculty guidance and project desk crits. Final projects will include a written and graphical report along with a presentation. Final presentations will be given before a panel of invited guests.

Submission

Each assignment will outline the specific requirements for its submission format. Generally speaking, homework assignments must be submitted via CourseWorks *and* submitted in printed, hard-copy format (black and white or full color, as appropriate) in class. Be advised that certain assignments will have digital due dates that are scheduled *before* class meets. Absolutely, no late assignments will be accepted.

Translation from Scores to Grades

Students are often understandably concerned with where the lines are drawn between "high pass," "pass," and "low pass." At the end of the semester, students are ranked by the cumulative, weighted scores and approximately the top 20% will receive a high pass.

If, by the University's Election Holiday, a student is in danger of receiving a grade lower than a pass, an individual meeting will be scheduled to discuss and outline what will be necessary to achieve a passing grade.

Expectation of Academic Honesty

As always and as with every other course, this class is conducted in accordance with University policy on matters of academic honesty and integrity. Note that instances of plagiarism will not be tolerated, whether in written text, in research design, or in data acquisition and creation. In research we build on the work of others: give credit where credit is due.

Additionally, this course contains a few considerations which should be stated. At several points in the semester, students will be encouraged to look to their peers for collaborative problem solving and

troubleshooting especially within the lab and studio settings. Except where otherwise stated in specific assignments, collaboration is welcomed but individual assignments must be conceived and completed individually.

4. **Resources & Materials**

Dropbox

All course materials will be located in a Dropbox account, which also contains the GIS data resources available for student use at GSAPP. The course materials are organized by week.

Within each week's archive (ZIP file), there are sub-folders for documents (exercises and assignments), readings, and geographic files (shapefiles, project files, data files, etc).

Recommended Purchases

An External Hard Drive: It is very highly recommended that everyone have an external hard drive to hold data for their assignments and final projects. We suggest a hard drive with a minimum capacity of 20 GB.

One book: *GIS for the Urban Environment* by Julie Maantay and John Ziegler is heavily assigned in the readings for this course. PDFs of readings are available on the X:\ drive, but these only constitute excerpts of a valuable text.

CourseWorks Discussion Board

If you have a question, it is likely that your peers may be presently working out the same issue or may have already found a solution. Students are encouraged to post questions on the CourseWorks discussion board and collectively work toward finding answers prior to emailing the TAs and professors. Learning GIS is a techniques-heavy endeavor with several moments that require critical problem solving skills. These skills are substantially better acquired when the solutions are derived through work than from asking your TA.

Office Hours & Meetings

Regular professor office hours will be held weekly on Tuesday 9-10pm, by request, in the Planning Studio, and through Google Hangout during weekdays.

The course TA, Jackie Sunwoo, will announce his office hours during the second week of class. She is also available by appointment.

Digital Service Science Center (DSSC)

Electronic Data Services is located on the lower level of Lehman Library and is a great resource for GIS data and technical questions. DSSC collects spatial data and may have what you need for your final project. Further, if they don't have the data you're looking for, the data librarians can usually help you find it. DSSC also has technical consultants available for questions regarding data as well as those related to performing certain GIS operations. Their facility is equipped with computer stations (with extremely nice monitors). Check their hours of operation before visiting on the Columbia Libraries website.http://library.columbia.edu/content/libraryweb/indiv/dssc.html

The Esri User Forum

There Esri user forum is an excellent resource for technical GIS software questions: http://forums.arcgis.com (Links to an external site.). It is very highly recommended that you search this forum when you have a question. It's almost a guarantee that someone has had the same issue and the forum is a very quick way to find immediate solutions.

Notes on Email

The professor and TA may not always be able to respond to email questions right away. Therefore, it is very important that you use the other resources available to you. There are several ways to find help if you need it, so please do not let an unanswered email hold you back. One of the greatest assets you will have in this course is your own time management and determination to answer your own questions. Use lab time and office hours wisely.

If you email a technical question to either the professor or TA, be sure to include enough information for us to adequately help you. Necessary information includes, but is not limited to, a complete description of what you are trying to accomplish and the problem you are encountering, any relevant information regarding the data sets you are using, the steps you have already taken to address your problem (so we don't tell you to do what you've already done), and any necessary screenshots to help us understand what you are doing when we cannot sit with you in front of a computer.

5. **Detailed Schedule**

WEEK 1 Course Introduction, What is GIS?, Understanding ArcGIS & GIS terminology

TUESDAY 6 September 2016

Lecture Course Administration, Syllabus, Introductions; What is GIS? A Brief History of GIS; A Discussion of GIS and Urban Planning

Lab Log into Esri Virtual Campus & Start Tutorials

THURSDAY 8 September 2016

Lecture	Elements of Cartography; Constructive Map Criticism
Lab	Esri Tutorials
Assigned	Homework 1: Modules 1 & 2 of Esri's Virtual Campus Tutorials (Please print out the exam certificate or exam result and bring to class on Thursday, 9/15. Alternatively, you can upload .jps on CourseWorks.)

WEEK 2	Making Maps: Maps & Spatial Analysis
TUESDAY	**13 September 2016**
Lecture	Types of Maps; Common Design Pitfalls
Readings	Kent and Klosterman: GIS and Mapping: Pitfalls... (required: for discussion)
	Maantay and Ziegler: Chapter 1 (required: for discussion)
	Longley et al: Chapter 1 (reference)
Lab	Week 2 In-class Exercise A: Map Composition in ArcGIS
	Week 2 In-class Exercise B: From ArcGIS to Illustrator

THURSDAY	**15 September 2016**
Due	Homework Week 1: Modules 1 & 2 of Esri's Virtual Campus
Lab	Finish Week 2 In-class Exercises A&B
Assigned	Homework Week 2: Working with Data and Creating Maps

WEEK 3	Working with Maps& Data
TUESDAY	**20 September 2016**
Lecture	Data Classification; Map Projections; Reading Metadata
Readings	Maantay and Ziegler: Chapter 4 (required: for discussion)
	Maantay and Ziegler: Chapter 2 (required)
	Maantay and Ziegler: Chapter 3 (required)
	Peterson (reference)
	Monmonier: Chapter 1 (reference)
Lab	Week 3 In-class Exercise: Joining Tables to Boundary Files

THURSDAY	**22 September 2016**
Due	Homework Week 2: Working with Data and Creating Maps

Lab Finish Week 3 In-class Exercise; Visualizing Data in ArcScene

Assigned Homework Week 3: Working with Tables: Joining Data & Querying

WEEK 4 Working with Census Data, Part 1

TUESDAY 27 September 2016

Lecture Understanding Census Data & Geometry; Accessing Census Data; Working with Microsoft Access

Readings Peters and MacDonald: Chapter 1 (required: for discussion)

Writing Effective Policy Memos (required: reference – located in ProblemSet1\documents\folder)

Assigned Problem Set: Policy Memo

Lab Week 4 In-class Exercise: Working with Census Data, Part 1

THURSDAY 29 September 2016

Due Homework Week 3: Working with Tables: Joining Data & Querying

Lab Finish Week 4 In-class Exercise

Additional class time reserved for work on Problem Set

WEEK 5 Working with Census Data, Part 2

TUESDAY 4 October 2016

Lecture Interpreting Census Variables; The Decennial Census Versus The American Community Survey; Charts & Graphs for Data Display

Readings Sclossberg (required: for discussion)

Peters and MacDonald: Chapter 2 (required: for discussion)

A Compass for Understanding and Using ACS Data: Appendix 1 (required: reference)

Monmonier. *Drawing the Line* (reference)

A Compass for Understanding and Using ACS Data (reference)

Lab Week 5 In-class Exercise: The American Community Survey

THURSDAY 6 October 2016

Lab Finish Week 5 In-class Exercise

Class time reserved for work on Problem Set

WEEK 6 Geoprocessing

TUESDAY **11 October 2016**

Lecture Geoprocessing Tools: Buffers, Clips, Unions

Readings Maantay& Ziegler: Chapter 9 (required: for discussion)

Lab Week 6 In-class Exercise: Geoprocessing

THURSDAY **13 October 2016**

Due Problem Set: Policy Memo

Lab Finish Week 6 In-class Exercise; Work on Week 6 homework

Assigned Homework Week 6: Area Calculation

WEEK 7 Geocoding

TUESDAY **18 October 2016**

Lecture What is Address Mapping? Location-based Services

Readings Maantay & Ziegler: Chapter 7 (required: for discussion)

DCPLION Single Line Street Base Map User Guide (reference)

Lab Week 7 In-class Exercise: Geocoding

THURSDAY **20 October 2016**

Due Homework Week 6: Area Calculation

Lab Finish Week 7 In-class Exercise; Work on Week 7 homework

Assigned Homework Week 7: Geocoding

Lecture ****Someone from DSSC will speak about library services to help you with your final projects** Please be seating promptly at 7:00pm.**

WEEK 8 Georeferencing& Editing

TUESDAY **25 October 2016**

Lecture Editing features: Point, Line, and Polygon; Rubbersheeting & Georeferencing; Introduce final project concept

Readings Maantay & Ziegler: Chapter 2 (required: for discussion)

Lab Week 8 In-class Exercise A: Georeferencing

Week 8 In-class Exercise B & C: Editing

THURSDAY **27 October 2016**

Due Homework Week 7: Geocoding

Readings Craft of Research: Chapters 3 & 4 (required: for discussion)

Lab Finish Week 8 In-class Exercises A, B, C

Assigned Homework Week 8: Georeferencing

****Guest Lecture: TBD****

WEEK 9 Beyond Esri & ArcGIS

TUESDAY **1 November 2016**

Lecture Working with Google; Web mapping; QGIS; Additional platforms and software

Readings Maantay & Ziegler: Chapter 12 (required: for discussion)

Lab Week 9 Exercise: Google Fusion Tables and/QGIS

THURSDAY **3 November 2016**

Due Homework Week 8: Georeferencing & Final Project Paragraph

Assigned Case Study Reading Response Paper

Lecture Raster Data; Decision Support Methods with Rasters & Reading Response Papers

Reading Cote (required: for discussion)

Week 10 terms ArcGIS (in Week 9\Readings\ folder)

WEEK 10 Raster Data and Raster-based Decision Support

TUESDAY **8 November 2016: NO CLASS ELECTION HOLIDAY**

THURSDAY **10 November 2016**

Due Final Project Paragraph & Case Study Reading Response Papers and Presentations (with discussion)

Discussion Final Project Proposals

Lab Reading response presentations

Assigned Homework Week 10: Rasters

WEEK 11 GPS Data Collection

TUESDAY 15 November 2016

Due Final Project Proposals

Lecture Field Surveys; GPS; Aerial Imagery; Creating Metadata

Readings GPS reading TBD

FGDC Metadata Guide (reference)

Lab Week 10 In-Class Exercise: Rasters

Assigned Homework Week 10: Rasters

THURSDAY 17 November 2016

****Guest Lecture** Speaker Sarah Almukhtar**

Lab Finish Week 10 Exercise; Additional class time reserved for Homework Week 10: GPS.

WEEK 12 Applications of GIS

TUESDAY 22 November 2016

GPS lecture

Work on Week 10 assignment

THURSDAY 24 November 2016

No class

WEEK 13 Final Project Development

TUESDAY 29 November 2016

Due Due: Homework Week 10

Desk Crits Class time reserved for Final Project development

THURSDAY 1 December 2016

Class time reserved for Final Project development

WEEK 14 Final Project Development

TUESDAY 2 December 2016

Desk Crits Class time reserved for Final Project development

THURSDAY 4 December 2016

Desk Crits Class time reserved for Final Project development

WEEK 15 Final Project Presentations

TUESDAY 13 December 2016

Due Final Project Presentations -- Everyone's presentation files are due, regardless of which day a student is scheduled to present.

Presentations Half the class will present their final projects

THURSDAY 15 December 2016

Presentations Half the class will present their final projects

FRIDAY 16 December 2016

Due Final Project Reports -- Everyone's reports are due on CourseWorks by 5pm.

6. Appendices

Quick-Reference Table of Assignments

Assignment	Note	% of Final Grade	Due Date
Reading Discussion	Participation	5%	Throughout the Semester
Homework		35% total	

	Week 1	5% (1 of 8)	15 September 2016
	Week 2	5% (2 of 8)	22 September 2016
	Week 3	5% (3 of 8)	29 September 2016
	Week 6	5% (4 of 8)	20 October 2016
	Week 7	5% (5 of 8)	27 October 2016
	Week 8	5% (6 of 8)	3 November 2016
	Week 10	5% (7 of 8)	15 November 2016
	Week 11	5% (8 of 8)	29 November 2016
Problem Set		15%	13 October 2016
Reading Response	Paper & Presentation	10%	22 November 2016
Final Project		35% total	
	Project Paragraph	5%	10 November 2016
	Project Proposal	10%	17 November 2016
	Presentation & Report	20%	13/15/16 December 2016

References for Required Reading

Cote, Paul. *Raster GIS Fundamentals*. 2008. <http://www.gsd.harvard.edu/pbcote/courses/gsd6322/08/raster/>.

Kent, Robert B. and Richard E. Klosterman. "GIS and Mapping: Pitfalls for Planners." *Journal of the American Planning Association.*2000. 66: 2, 189-198.

Maantay, Julie and John Ziegler.*GIS for the Urban Environment*. Redlands, CA: Esri Press, 2006.

Peters, Alan H. and Heather MacDonald.*Unlocking the Census with GIS*. Redlands, CA: EsriPress, 2004.

Schlossberg, Marc. "GIS, the US Census and Neighbourhood Scale Analysis."*Planning, Practice & Research.* 2003, 18(2-3): 213-217.

Reference Reading

Longley, Paul A, et al, Eds. *Geographical Information Systems and Science (2nd Ed)*.Hoboken, NJ: John Wiley & Sons, 2005.

Monmonier, Mark. *Drawing the Line.* New York: Henry Holt and Co, 1995.

Peterson, Gretchen. *Colors for Maps*. 2011.

US Census Bureau.*A Compass for Understanding and Using American Community Survey Data: What General Users Need to Know* (Issued October 2008). Washington, DC: US Census Bureau, 2010.