

New York University
Robert F. Wagner Graduate School of Public Service

URPL-GP 2690 Advanced Geographic Information Systems and Data Management
Fridays, March 23, 30, April 13, 20 and 27, May 4, 2012
2:00am to 5:00pm; 194 Mercer Street, Room 304

COURSE SYLLABUS

Professor Zvia Segal Naphtali Home/office phone 212-877-1475
Office Hours: Before & after class or by appointment.

zvia.naphtali@nyu.edu

Course Prerequisites:

Students taking the Advanced GIS course should have completed the earlier classes
URPL-GP 4648 Geographic Information Systems (GIS) in Urban Planning I
URPL-GP 4649 Geographic Information Systems (GIS) in Urban Planning II.
These classes are offered by Prof. Naphtali in the Fall and in the Summer.

Students that completed GIS courses elsewhere should contact Prof. Naphtali prior to enrolling in this course.

Course Requirements and Grading

A Final Project Paper is due on the last day of class, May 4, 2012 (50% of the grade). Students are required to submit a proposal for the Final Project paper on April 20 (the 4th day of class). Students are required to complete four Homework Assignments (40% of the grade). A reading report is due on the last day of class, May 4, 2012 (10% of the grade). Further details on these three assignments are available on pages 7-8 of this syllabus. Note that attending all the six days of this class is required.

Required Reading:

The books listed below are available at the NYU Bookstore. Copies of all books have also been placed on reserve in Bobst Library. These books are available from the ESRI Press and Amazon.

1. Christian Harder, Tim Ormsby and Thomas Balstom, *Understanding GIS: An ArcGIS Project Workbook*, (ESRI Press, 2011) ;
2. Tim Ormsby, et. al. *Getting to Know ArcGIS Desktop, ArcMap 10* (ESRI, 2010).
3. David W. Allen and J.M. Coffey, *GIS Tutorial 3: Advanced Workbook*, (ESRI, 2011).

The following recommended books are available on reserve at Bobst. Chapters will be assigned.

1. Wilpen L. Gorr and Kristen S. Kurland, *GIS Tutorial for Crime Analysis* (ESRI 2012);
2. Wilpen L. Gorr and Kristen S. Kurland, *GIS Tutorial 1: Basic Workbook*, (ESRI 2010)
3. David W. Allen, *GIS Tutorial 2: Spatial Analyst Workbook* (ESRI Press, 2009)Margaret
4. M. Maher, *Lining up Data in ArcGIS* (ESRI Press, 2010)

Other books of interest:

1. Juliana Maantay & John Ziegler, *GIS for the Urban Environment* (ESRI 2006).
2. Kathryn Keranen and Robert Kolwood, *Making Spatial Decisions: Using GIS A Workbook* (ESRI Press, 2012).
4. David W. Allen, *Getting to Know ArcGIS ModelBuilder* (ESRI 2011);
5. Heather MacDonald and Alan Peters, *Urban Policy and the Census*, (ESRI 2011)
6. Gina Clemmer, *The GIS 20 Essential Skills*, (ESRI Press, 2010)
7. Cynthia Brewer, *Designed Maps*, (ESRI Press, 2008).
8. Alison Butler, *Designing Geodatabases for Transportation* (ESRI Press, 2008)
9. *The Zoning Handbook* (2011) NYC Dept. of City Planning Bookstore
<http://www.nyc.gov/html/dcp/html/pub/zonehand.shtml>
10. Ric Skinner (editor) *GIS in Hospital and Healthcare Emergency Management* (CRC Press, Taylor & Francis Group, 2010).
11. R. W. Greene, *Confronting Catastrophe: A GIS Handbook* (ESRI Press, 2002).
12. Andy Mitchell, *The ESRI Guide to GIS Analysis, Spatial Measurement and Statistics*, Vol. 2. (ESRI, 2005); Volume 1 is also recommended. Available as eBooks.
13. Robert Burke, *Getting to know ArcObjects: VBA Programming* (ESRI Press, 2003).

Students who have not taken the GIS I and GIS II classes recently should complete the exercises in the following chapters in the book listed below before the first class.

Tim Ormsby, et. al., *Getting to Know ArcGIS Desktop*, exercises in Chs. 5-9;

All students should examine the chapters in the following book before the first class

Christian Harder, Tim Ormsby and Thomas Balstom, *Understanding GIS: An ArcGIS Project Workbook*, (ESRI Press, 2011) ; Chapters 1-3

GIS and Climate Trend Analysis: Students are encouraged to examine materials available on the Nature Conservancy website at <http://climatewizardcustom.org/>
See also <http://www.esri.com/library/bestpractices/climate-change.pdf>

GIS in Africa <http://www.esri.com/library/bestpractices/gis-in-africa.pdf>

See also a shaded relief map of Israel with Planimetric details, such as roads and streams.
http://www.esri.com/mapmuseum/mapbook_gallery/volume21/cartography6.html. This volume of the Mapbook gallery has interesting maps.

Please take notes on what you learned from inspecting the websites on **GIS and Climate** and **GIS in Africa**. Print your notes and come prepared for a class discussion.

Course Description

The course *Advanced Geographic Information Systems and Data Management* is designed to build upon and extend the knowledge and skills students acquired in the GIS I and GIS II classes or through their hands-on experience using GIS elsewhere.

The course will cover a selection of advanced GIS methods and techniques that are currently available in ArcGIS 10. Students will also be introduced to, and learn to work with, a number of the extensions to ArcGIS 10. These include Spatial Analyst, Network Analyst, Maplex, and 3D Analyst. Students will be introduced to and work with raster and terrain data as well as continuing to work with vector data (points, lines and polygons).

In this Advanced GIS course, students will learn to design professional looking maps which they will save as Map Books -- a collection of pages printed or exported together. Pages in a Map Book can contain maps, other pages may be dedicated to text, tabular information, tables of contents, or title pages and other content. This is a utility in ArcMap. It provides a wizard that automates Map Book production and you can print or export any or all of the pages in a map book. Students will be asked to submit their Final Projects as a Map Book

Students will continue learning to plan, design, search for, download, and prepare data for real-world GIS projects but in more sophisticated ways than in the previous classes.

Homework Assignments will expand on the exercises and case studies that students will work on during class. Details will be available in the expanded syllabus which will be placed on Blackboard before class begins.

Class Schedule

On March 23rd, the first day of class, students will be introduced to mapping raster and terrain data. They will also continue working with vector data (points, lines and polygons).

In the first class exercise, students will map coastal flooding from Hurricane Katrina and the Hurricane Wilma storm surge and be introduced to mapping raster and terrain data. The exercise will include an introduction to the ArcGIS Spatial Analyst extension. In a second exercise, students will prepare maps of a Category 4 Hurricane and its effects on Manhattan. They will be using data available on the NYS GIS Clearing House at

<http://www.nysgis.state.ny.us/gisdata/inventories/details.cfm?DSID=1043>

Some background reading:

- (1) Wilpen L. Gorr and Kristen S. Kurland, "ArcGIS Spatial Analyst" in Chapter 11, in *GIS Tutorial 1: Basic Workbook*, (ESRI 2008);
- (2) David W. Allen *GIS Tutorial 2: Spatial Analysis Workbook*, "Tutorial 3-3: Creating A Density Surface" pp. 93- 99.

A discussion of the pre-class exercises and the publications on *GIS and ClimateTrend Analysis*. and *GIS in Africa* will take place at the beginning of this first class

<http://www.esri.com/library/bestpractices/climate-change.pdf> and
<http://www.esri.com/library/bestpractices/gis-in-africa.pdf>.



GUEST PRESENTATION To be announced

On March 30, the second day of class, students will be introduced to planning, designing, creating and populating geodatabases. Geodatabases are the common data storage and management framework for ArcGIS data. Geodatabases combines "geo" (spatial data) with "database" (data repository) to create a central data repository for spatial data storage and management.

Students will prepare and populate a geodatabase with data for the Greenpoint-Williamsburg area of Brooklyn. They will next use the Greenpoint-Williamsburg geodatabase to prepare some maps. Students will also be introduced to the uses of the MAPLEX extension in improving labeling.

In this first class exercise, students will also use the **3D Analyst** extension to view and analyze land use patterns in Greenpoint-Williamsburg.

The second part of the class will introduce students to Projecting Maps in ArcMap. It is recommended that students read Chs. 1-3 in Margaret M. Maher's book, *Lining up Data in ArcGIS: A Guide to Map Projections* (The book is available on reserve at Bobst).

On April 13, the third day of class, students will be introduced to the Georeferencing toolbar in ArcMap. They will learn to create maps from scanned images (tiff or pdf) which involves connecting control points from the scanned image to the corresponding points on the Lion Street file. Students will work with two examples:

(1) Students will learn to "register" the boundaries of raster image of the Greenpoint-Williamsburg "G_W Contextual Rezoning" to the street map - the LION file.

The Greenpoint-Williamsburg raster image of the "contextual rezoning map" will be downloaded from a PowerPoint/Slide Show presentation available on the NYC Department of City Planning website

http://www.nyc.gov/html/dcp/html/greenpointwill_con/index.shtml.

(2) Students will next learn to "register" a tiff file of the "G_W_Historic_District.shp" to the LION Street map. The "tiff" file will be downloaded from the NYC Landmarks Preservation Commission website <http://www.nyc.gov/html/lpc/downloads/pdf/maps/greenpoint.pdf>. Chapters in the Allen and Coffey, *GIS Tutorial 3: Advanced Workbook* will be assigned.

GEOCODING: The second part of the class, students will be introduced to advanced methods geocoding data. For example, they will gain more experience in “rematching” with the Interactive Rematch dialog box, in modifying the address locator's setting by adding or changing the place-name alias table, and more. Note that the Homework Assignment will involve further work on Geocoding.

On April 30, the fourth day of class, students will be introduced to the uses the **ArcGIS ModelBuilder**, a graphic design tool for diagramming solutions to complex spatial analysis problems. ModelBuilder combines a number of geoprocessing tools such as buffer, intersect, union, or dissolve, and automates the work in ArcGIS. Prior to this class, students will be asked to review several chapters in Tim Ormsby, et. al. *Getting to Know ArcGIS Desktop, ArcMap 10* including Chapter 14. Also required will be chapters in David W. Allen and J.M. Coffey, *GIS Tutorial 3: Advanced Workbook* and in David W. Allen, *Getting to Know ArcGIS ModelBuilder* will be recommended.

The uses of ModelBuilder will be introduced using case studies. One of the case studies, for example, will focus on the relationship between subway ridership on five stations on the Queens #7 Subway Line and selected demographic and socio-economic indicators (such as population density, crowding, race and ethnicity) and car ownership.

Students will also be introduced to the Python scripts that are created by ModelBuilder. They will learn to create schematic diagrams of the methodology for the analysis and to add documentation to their models. They will also learn to export models to scripts, to make their models portable and more.

Another example of ModelBuilder to be covered in class will involve building models for analyzing and displaying crime data. The exercise will be based on chapter 10 in Wilpen L. Gorr and Kristen S. Kurland, *GIS Tutorial for Crime Analysis* (ESRI Press, 2012);

Time permitting, students will start working on an exercise that involves mapping data on Fueling Stations Locations for Alternative Fuels (AFS) at various distances from Interstate Highways across the United States. The data will be downloaded from the US Dept. of Energy website at http://www.afdc.energy.gov/afdc/data_download/download

April 27, the fifth day of class, will be devoted to learning about the uses of the **Spatial Statistics Tools** in ArcGIS 10. Students will be introduced to using “Hot Spots” analysis in analyzing crime data.

Students will learn to build crime animations in ArcMap, that is, how to symbolize crime data showing changes through time. The temporal animations can be viewed in ArcMap as well as exported to videos.

Students will also learn how to geocode crime data, and how to automate crime mapping using ModelBuilder. The exercises will be mostly based on materials in the new book by Gorr and Kurland, *GIS Tutorial for Crime Analysis* (ESRI 2012).



GUEST PRESENTATION Christopher R. Herrmann on “Underneath the Hot Spot: What is causing all that crime?,” an Adjunct Professor, CUNY John Jay College of Criminal Justice. He is a Doctoral student at the CUNY Graduate Center; Research Analyst, Criminal Justice Research & Evaluation, the Center for Crime Prevention and Control.

On May 4, the sixth and last day of this class, students will complete a number of exercises on the **Uses of GIS in Emergency Management**. The exercises will introduce students to the uses of **Network Analyst**, an extension of ArcGIS. Using a fire station layer and a street layer, they will learn to perform **response time analysis** and complete some **travel time modeling** exercises that will focus on a fire department tasks.

Fire companies must be able to respond promptly. Response time can make the difference between the rescue of occupants of buildings versus serious injury and death. For example, when a fire occurs Network Analyst can help in locating the fire stations that can provide the quickest response to a fire at a given address. With Network Analyst one can generate routes and driving directions for the firefighters to follow. Fire departments are using the Network Analyst extension in ArcGIS to reduce critical response time and increase efficiency.



TENTATIVE:

Guest presentations by GIS professionals from the NYC Fire Dept. or OEM.

To summarize, in the course of the six days of the Advanced GIS class, students will be working on a number of extended mapping projects that will include urban planning and analysis, transportation planning; crime analysis using advanced statistical techniques; housing, including mortgage foreclosures patterns, and emergency management such as mitigation, preparedness, response and recovery, and more. The case studies and exercises to be completed in this Advanced GIS class will be more challenging and will cover many aspects of Advanced GIS applications.

DATA MANAGEMENT

Throughout this Advanced GIS class, students will complete a number of exercises specifically designed to enhance their data management skills.

Students will learn to download data from a number of websites and prepare the data for analysis in ArcMap. These websites include the US Dept. of Energy, the NYS GIS Clearing House, the US Census Bureau (with more recent Census data from the latest American Community Survey), the New York State Data Center, the New York City Department of

City Planning, Infoshare, Geolytics and websites with environmental data such as the New York State Department of Environmental Conservation and from the EPA website.

Students will learn to work with data in a variety of formats such as ASCII, Excel, Access, SPSS, dBase, etc., and to prepare the data for mapping and analysis in ArcMap.

It is anticipated that by the end of this Advanced GIS class, students will have good working knowledge of geodatabase design and management, modeling, spatial and network analysis, spatial statistics and more. They will greatly improve their ArcGIS mapping skills including geoprocessing, modeling, geocoding, spatial statistics techniques and more.

Note that the uses of GIS are explored from a management point of view, as well as that of the GIS specialist.

HOMEWORK ASSIGNMENTS, REPORTS ON READING & THE FINAL PROJECTS PAPERS

FOUR HOMEWORK ASSIGNMENTS:

40% of your grade: Students are required to complete four homework assignments. These will continue and extend, in most cases, the exercises they will work on in class.

The homework assignments, like the class exercises, must be saved as mpks. The maps that students will design for the homework exercises must also be saved as pdf files and inserted into a PowerPoint. The maps should also be inserted into the Word document that describes the experience students have had in completing the assignments.

The written and printed notes (three pages or more) should comment on what students learned completing the homework assignments as well providing an account of the challenges students faced. The maps and the Word document should be printed in color. The mpks, the pdfs, the PowerPoint and the notes must be saved on the USB submitted to Prof. Naphtali each class. The USBs will be returned to students each week and at the end of this course.

ONE WRITTEN REPORT ON READING: DUE: May 4, 2012

10% of your grade: Students must read the course materials and be prepared for a class discussions of what they read. In the Reading Report (five pages or more) students should comment on what they read during this course. They will be assigned to read chapters in the required books and will also be asked to read chapters in one of the recommended books on reserve. Further details on the report on reading will be available in class.

A FINAL PROJECT PAPER 50% of your grade DUE: Class 6, May 4, 2012

In this GIS course students will be introduced to more advanced data management and mapping skills than those covered in GIS I and II. They will also be working with a number of case studies that will introduce them to these advanced GIS skills. The Final Project Paper should reflect these newly acquired skills including saving their work in Map Books.

For their Final Project papers, students must design, build and populate a geodatabase, and use ModelBuilder. Finally, students must report, in a written document, on the challenges they encountered completing their Final Project as well as report on what they learned. The Final Project Paper must also include a review the literature on the subject of the paper and a discussion of three or more scholarly articles related to the topic of their GIS project. A full discussion of the data management steps that were required to complete these tasks should be included in the Final Project Paper.

Students may expand on any of the case studies/projects introduced in this course and use them for their Final Project Papers. Students may use the data prepared by Prof. Naphtali for this class but must add more map layers to it. Students choosing to work on their own topics will have to search for suitable data on the internet, or use data available to them through their work or elsewhere. They will have to process the data for ArcMap (using Excel, Access, SPSS or Stata) and prepare it for mapping.

More details about the requirements of the Final Project will be available in class. Sample projects from previous years will be available for inspection.

How Long Should the Final Paper Be?

What should students submit?

Students must hand in a written Final Project Paper and it should be at least five pages long. In addition, they must attach at least six full-size printed color maps to the written paper. The maps should also be embedded in the MS. Word document (the paper). The paper must be accompanied by a printed PowerPoint in color. The paper should also be submitted as a Map Book. Students are also required to attach a USB to the Final Project paper that will contain all the data they used for the project and stored in a Geodatabase. They must submit the mpks, pdfs and a PowerPoint and a printed copy of the Paper and also their Report on Reading.

Students should be ready to present their Final Projects on the last day of class May 4,

By the end of this Advanced GIS course students should have excellent working knowledge of spatial analysis, geodatabase design and management, and of mapping with ArcGIS. Students will be able to apply the GIS skills and the knowledge they acquired in this class immediately in their current work, in Capstone projects, and in their future public service professional careers.