USP 531: GEOGRAPHIC INFORMATION SYSTEMS FOR PLANNERS **Fall Quarter 2005**
CRN 14186, 4 credit hours
Newberger Hall (NH) 450 **Mon. & Wed., 6:40-8:30 PM**

Instructor: Irina V. Sharkova, Ph.D.
Population Research Center & School of Urban Studies and Planning
Urban Center, 5th floor, Rm. 570M
503-725-5160
sharkovai@pdx.edu

Office hours: Mondays and Wednesdays noon to 2 PM, and by appointment

Teaching Assistant: Warren Greaser (MURP): <wgreaser@pdx.edu>
Assisted GIS Lab (URBN 225) hours: Mondays from 1 to 4 PM; Thursdays from 7 to 10 PM

COURSE DESCRIPTION AND OBJECTIVES

This course is an introduction to Geographic Information Systems (GIS) and their applications to urban and regional studies and planning. It presents principles, methods, and uses of geographic analysis, explores sources and types of spatial (geographic) data, and discusses strengths and limitations of geospatial technologies such as GIS in solving societal problems. Students will learn how spatial data differs from other types of data, what kind of spatial data to use and when, what methods of analysis to apply and why, and how to best present the results for planning and other audiences.

A particular emphasis will be placed on issues of data quality and applicability to planning and related tasks, data comparability over time and geographic space, and uses of governmental data sources including Decennial Census in typical planning applications. The course will also closely examine principles and methods of communication of spatial and other information, with a focus on map design.

Theoretical components of the course will be closely integrated with its practical components. Students will develop essential skills in geographic analysis and desktop mapping using GIS and spreadsheet software through their independent work in the computer laboratory. Three types of hands-on tasks will help students build their skills in ArcGIS 9.1: exercises with step-by-step instructions, more independent assignments with generic instructions, and an individual term project.

In addition to the lectures and work in the lab, students will use WebCT, an online educational tool (URL http://www.webct.pdx.edu/), to submit their work, participate in discussions, get updates and detailed information about weekly homework, and to communicate with the instructor and the teaching assistant.

Required readings

1. Longley, Paul A., Goodchild, Michael F., Maguire, David J., and Rhind, David W. (2005). *Geographic Information Systems and Science*. 2nd Edition. John Wiley & Sons and ESRI Press.
2. William Huxhold, Eric M. Fowler, Brian Parr (2004). *ArcGIS and the Digital City: A hands-on approach for local government.* ESRI Press.
3. Articles and other reading materials posted in WebCT (check weekly "Homework" info).

Recommended readings

1. Cynthia A. Brewer (2005). *Designing Better Maps: A Guide for GIS Users*. ESRI Press.
2. Alan Peters, Heather MacDonald (2004). *Unlocking the Census with GIS*. ESRI Press.
3. Edward R. Tufte (1997). *Visual and Statistical Thinking: Display of Evidence for Making Decisions*. Graphics Press: Cheshire, CT.
4. Edward R. Tufte (2003). *The Cognitive Style of PowerPoint*. Graphics Press: Cheshire, CT.

Practical components

You will develop essential skills in ArcGIS 9.1 as you progress from exercises with step-by-step instructions to more independent assignments where you will be given only generic instructions and, finally, to an individual term project.

You will use several sources for exercises: two online courses from the ESRI Virtual Campus ("Leaning ArcGIS 9" and "Leaning ArcGIS 9 Spatial Analyst"), a manual *ArcGIS and the Digital City,* and instructions on geocoding available in WebCT.

Two assignments will be organized around a specific planning-related research topic(s) that each student will choose individually; however, the assignments will follow a pre-defined format. A typical assignment would involve working with data and producing and analyzing maps about the 6-county Portland-Vancouver metropolitan region and its parts.

A project will investigate a planning-related problem of your choice using GIS methods. You will start with preparing a project proposal that you will discuss with the instructor. The results of the project will be presented in class at the end of the term. Detailed project instructions are available in WebCT.

Special needs

If you have a disability and are in need of academic accommodations, please notify the instructor immediately to arrange needed supports.

EVALUATION METHOD

Final grades will be established on the basis of:

- Exercises from *ArcGIS and the Digital City* and other sources 20%
- Assignments (2), 10% each 20%
- Project 25%
- Discussion lead (1 article) 10%
- Participation 10%
- Final exam 15%

Late work will be marked down unless arrangements with the instructor were made in advance. Regular *class attendance* is necessary and expected; if you absolutely have to miss a class, you need to make arrangements with the instructor in advance.

In-class discussion of 2-3 assigned articles will take place every Wednesday, from October 5th through November 23rd. Each student will choose one article from the list posted in WebCT and serve as a discussion lead once during the term. A discussion lead will be responsible for preparing several discussion questions, distributing them in advance in WebCT, and then leading the discussion in class. The rest of the students will read the articles and prepare for the discussion using these questions. Detailed instructions are available in WebCT.

To earn points for participation, you have to be active in class and contribute to your own learning experience and that of your fellow students. Means to do so include starting and participating in discussions, both in-class and online (in WebCT), asking substantive questions, answering instructor's questions, sharing relevant news and information, etc. Please note that regular class attendance is a necessary but not sufficient condition for earning points for participation.

Citing work of others

When writing an essay or a report, remember to always properly cite your sources, including textbook, online, and lecture materials. Typically, a list of sources (bibliography) is the final section of an assignment or a report.

TOPICAL OUTLINE

Week 1

Sept. 26 Course introduction. Solving geographic problems

1. Course and WebCT introduction
2. Asking geographic questions
3. The role of maps in geographic knowledge discovery
4. Planning as intelligence-gathering and policy development
5. History of GIS. GIS applications to planning

Sept. 28 Types, uniqueness, challenges of geographic data and analysis

1. Geographic phenomena and relationships
2. Tobler's First Law of Geography
3. MAUP (Modifiable Areal Unit Problem)
4. Ecological fallacy
5. Geometric and topological properties of geographic data

Week 2

Oct. 3 Geographic data models and data structures

1. Data characteristics and measurement scales
2. Map scale
3. Geographic data models: vector, raster, and object-based models
4. Geographic data structures: shape files, coverages, grids, TINs
5. Topological data structure and its uses

Oct. 5 Obtaining geographic data. CADD. Georeferencing.

1. Geographic data development: digitizing, scanning, remote sensing, GPS
2. Using CADD data in GIS
3. Cadastral maps. Public land survey system
4. Projections, their types and uses

Week 3

Oct. 10 Organizing, storing, and sharing geographic data. Geodatabases. RLIS

1. Database management systems
2. Geodatabases
3. Relational databases; joining spatial and attribute data in ArcGIS
4. Components of an urban geographic information system. Metro RLIS data

Oct. 12 Spatial analysis in GIS I: queries and measurement. RLIS

1. Spatial analysis – the core strength of GIS
2. Locating and identifying spatial objects
3. Defining spatial characteristics
4. Measuring length, perimeter, area, distance
5. Simple queries (by attribute) & their uses
6. Components of an urban geographic information system. Metro RLIS data

Week 4

Oct. 17 Spatial analysis in GIS II: spatial overlay and reclassification

1. Spatial overlay principles and functions
2. Spatial queries (by location)
3. Buffers, their types and uses

4. Reclassification of spatial objects
5. Role of topology and geodatabases for spatial overlay
6. Uses and limitations of spatial overlay for attribute data allocation

Oct 19 Sources of attribute and spatial data: US Decennial Census

1. US Decennial Census: history, politics, uses
2. Census short- and long form data
3. Summary tabulations
4. Public Use Microdata Samples; PUMAs
5. Comparability between Censuses
6. Data on race and ethnicity in Censuses 1990 and 2000
7. Census data strengths and limitations

Week 5

Oct. 24 American Community Survey. Data for local area analysis

1. American Community Survey: implications for planners and other users
2. Current Population Survey, US Economic Census; other federal data sources
3. Geographic hierarchy of Census data, TIGER/Line files
4. Local area analysis: normalization of numerical data; statistics; Index of Dissimilarity
5. Descriptive and summary statistics and charts in Excel and ArcGIS

Oct. 26 Administrative records. Geocoding

1. Using point data in planning
2. Types and sources of administrative records
3. Geocoding: turning administrative records into spatial data
4. Geocoding methods and data requirements
5. Quality and limitations of geocoded data

Week 6

Oct. 31 Using maps in planning. Map types.

1. Maps for exploration, analysis, and representation of geographic data
2. Locator maps: displaying location, neighbors, routes
3. Thematic maps: portraying distribution, count, magnitude
4. Choropleth maps and their uses
5. Other map types: dot-density, proportionate symbol, qualitative

Nov. 2 Data classification for thematic maps

1. Data considerations for choropleth maps
2. Classification types: which one is better?
3. Use of color for choropleth maps. ColorBrewer

4. Limitations of choropleth maps
5. Dasymetric mapping.

Week 7

Nov. 7 Principles of data visualization. Map design. Ethics of map development and use

1. Principles of map design
2. Map design process; controls on map design
3. Map elements, informative titles, creative labeling
4. Other methods of geographic data visualization
5. Maps: using or abusing? Ethics of mapmaking

Nov. 9 Spatial analysis with raster GIS and TINs

1. Raster data models, their strengths and limitations
2. Analysis with raster GIS: local, neighborhood (zonal), and global functions
3. Map algebra
4. Spatial Analyst in ArcGIS 9.1
5. Representing spatial data in 3-D. TIN data models

Week 8

Nov. 14 Spatial analysis in GIS III: spatial statistics; advanced modeling

1. Descriptive statistics involving location
2. Optimal location of services, optimal routes
3. Hypothesis testing for geographic problems
4. Spatial modeling and its applications
5. ModelBuilder in ArcGIS 9.1

Nov. 16 Uncertainty and error. Geographic data quality and data standards

1. Geographic data quality: error, accuracy and precision
2. Factors affecting spatial data quality
3. Propagation of error and uncertainty
4. Geographic data standards. Metadata, its formats and uses
5. Role of estimates in secondary data development.
6. Commercial data sources: benefits and shortcomings

Week 9

Nov. 21 Applications of GIS to predictive planning. Planning Support Systems

1. Spatial Decision Support Systems: GIS for decision-making
2. Planning Support Systems (PSS): definitions, goals, requirements
3. PSS examples: INDEX; What if? ; CommunityWiz
4. Strengths and limitations of PSS

Nov. 23 Social and cultural context of GIS. Public Participation GIS. Future trends in GIS

1. Access to geographic information
2. Ethical and legal aspects of GIS
3. GIS and community empowerment
4. Public Participation GIS: examples and lessons learned
5. Future of GIS

Week 10 Presentations

Week 11 Presentations and Final exam

IMPORTANT DATES

PROJECT OUTLINE due by 4 PM on Oct. 26 (via WebCT email)

EXERCISES due by 4 PM on Monday (via WebCT email):

- Sept. 28 (Wed) Accessing WebCT
- Oct. 10 "Learning ArcGIS 9" (Virtual Campus) Modules 1, 3, 4 (Part 1), 5
- Oct. 17 "Learning ArcGIS 9" Mod. 4 (Part 2), 6; "ArcGIS & Digital City" Ch. 1 (all)
- Oct. 24 "ArcGIS & Digital City" Ch. 2 (all)
- Oct. 31 "Geocoding"; "ArcGIS & Digital City" Ex. 3a, 3b
- Nov. 7 "Learning ArcGIS 9" Mod. 2; "ArcGIS & Digital City" Ex. 3c-3e
- Nov. 14 "Learning ArcGIS 9" Mod. 8; "Learning ArcGIS 9 Spatial Analyst" Mod. 1
- Nov. 21 "Learning ArcGIS 9" Mod. 7; "ArcGIS & Digital City" Ch 4 (all)

ASSIGNMENTS due by 4 PM on:

- Nov. 9 (Week 7) - Assignment 1
- Nov. 23 (Week 9) - Assignment 2

FINAL EXAM in room NH 450 on Monday, December 5, at 7:30-9:20 PM.

Week/ Date	Weekly Topics	Reading	Exercises & Assignments
		Complete by the following class meeting	*Complete by the following Monday (4 PM) except as noted*
Sept. 26	Introduction.	Longley et al. Ch 1, 7	Accessing WebCT (due 9/28 by 4 PM)
Sept. 28	Types and uses of geographic data. GIS software. ArcGIS	Longley et al. Ch 2, 3, 8	"Learning ArcGIS 9" Mod. 1 (due on 10/10)
Oct. 3	Geographic data models and data structures. CADD.	Longley et al. Ch 5, 9	"Learning…" Mod. 4 (part 1)
Oct. 5	Obtaining geographic data. Georeferencing.	Longley et al. Ch 10, 11	"Learning…" Mod. 3, 5
Oct. 10	Organizing, storing, and sharing geographic data. Geodatabases	Longley et al. Ch 4, 14 (except 14.4-14.5)	"Learning…" Mod. 4 (part 2); "ArcGIS & Digital City" exercises 1a-1d
Oct. 12	Spatial analysis in GIS I: queries and measurement.	Longley et al. Ch 14 (14.4-14.5), Knaap Ch 2	"Learning…" Mod. 6; "City" 1e-1i
Oct. 17	Spatial analysis in GIS II: spatial overlay and reclassification. RLIS	Peters Ch 1, NAS 2002	"City" 2a, 2d, 2e
Oct. 19	Sources of attribute and spatial data. US Decennial Census	Schlossberg 2003; "American Community… HUD"	"City" 2b, 2c, 2f
Oct. 24	American Community Survey. Data for local area analysis	Drummond 1995	"City", 3a, 3b
Oct. 26	Administrative records. Geocoding Project outline due.	Longley Ch 12 (except 12.3); Monmonier Ch 6	"Geocoding"; *start Assignment 1* (due 11/9)
Oct. 31	Using maps in planning. Map types.	Longley et al. Ch 12 (12.3); Kent/Klosterman 2000	"City", 3c-3d
Nov. 2	Data classification for thematic maps	Brewer (TBA); Myers Ch 5; Tufte (2003)	"Learning…" Mod. 2; "City", 3e
Nov. 7	Principles of data visualization. Map design	Longley et al. Ch 13; TBA	"Learning…" Mod. 8
Nov. 9	Spatial analysis with raster GIS and TINs Assignment 1 due.	Longley et al. Ch 15, 16	"Learning ArcGIS 9 Spatial Analyst" module 1; *start Assignment 2* (due 11/23)
Nov. 14	Spatial analysis in GIS III: spatial statistics; advanced modeling	Longley et al. Ch 3 (review 3.8), 6	"Learning" Mod. 7
Nov. 16	Uncertainty and error. Geographic data quality and data standards	Geertman, Stillwell 2004	"City", 4a, 4b
Nov. 21	Planning Support Systems	Longley et al. Ch, 18, 19, 20	*Working on Assignment 2* (due 11/23)
Nov. 23	Social and cultural context of GIS. PPGIS. Assignment 2 due.		
Nov. 28	Presentations. *Final exam distributed.*		
Nov. 30	Presentations.		
Dec. 5	Presentations. Project due. Final exam due.	*Class meets from 7:30 to 9:20 PM in NH 450*	

Articles for discussion

1. Al-Kodmany, Kheir (2000). Extending Geographic Information Systems to Meet Neighborhood Planning Needs: The Case of Three Chicago Communities. *URISA Journal*, Vol. 12 (3): 19-37.
2. Appleton, Katy, Andrew Lovett (2005). GIS-based Visualisation of Development Proposals: Reactions from Planning and Related Professionals. *Computers, Environment and Urban Systems*, Vol. 29: 321–339.
3. Baum, Howell S. (2004). Smart Growth and School Reform. *Journal of the American Planning Association*, Vol. 70 (1): 14-27.
4. Bolin, Bob, Amy Nelson, Edward J Hackett, et al. (2002). The Ecology of Technological Risk in a Sunbelt City. *Environment and Planning A*, Vol. 34: 317-339.
5. Eliot Allen. INDEX: Software for Community Indicators. Online, http://www.crit.com/documents/ESRIChapter.pdf
6. Frank, Lawrence D., Thomas L. Schmid, James F. Sallis, James Chapman, Brian E. Saelens (2005). Linking Objectively Measured Physical Activity with Objectively Measured Urban Form: Findings from SMARTRAQ. *American Journal of Preventive Medicine*, Vol. 28 (2), Supplement 2: 117-125.
7. Galster, George, Chris Hayes, and Jennifer Johnson (2005). Identifying Robust, Parsimonious Neighborhood Indicators. *Journal of Planning Education and Research*, Vol. 24: 265-280.
8. Hiller, Amy E., Dennis P. Culhane, Toney E. Smith, C. Dana Tomlin (2003). Predicting Housing Abandonment with the Philadelphia Neighborhood Information System. *Journal of Urban Affairs*, 25 (1): 91-105.
9. Landis, John (2001). Characterizing Urban Land Capacity. In "Land Market Monitoring for Smart Urban Growth" (Knaap, Gerrit J., Editor). Cambridge, MA: Lincoln Institute of Land Policy.
10. Loukaitou-Sideris, Anastasia, Robin Liggett, and Hiroyuki Iseki (2002). The Geography of Transit Crime: Documentation and Evaluation of Crime Incidence on and around the Green Line Stations in Los Angeles. *Journal of Planning Education and Research*, Vol. 22:135-151.
11. Maantay, Juliana. A. (2002). Mapping Environmental Injustices: Pitfalls and Potential of Geographic Information Systems (GIS) in Assessing Environmental Health and Equity. *Environmental Health Perspectives*, Vol. 110, Supplement 2: 161-171.
12. Sanchez, Thomas (1999). The Connection between Public Transit and Employment: the Cases of Portland and Atlanta. *Journal of American Planning Association*, 65(3): 284-296.
13. Song, Y. and G.J. Knaap (2004). Measuring Urban Form: Is Portland Winning the War on Sprawl? *Journal of American Planning Association*, Vol. 70 (2): 210 - 225.
14. Talen, Emily (1998). Visualizing Fairness: Equity Maps for Planners. *Journal of American Planning Association*, Vol. 64 (1): 22-38.
15. Talen, Emily (2002). Pedestrian Access as a Measure of Urban Quality. *Journal of Planning Practice & Research*, Vol. 17 (3): 257–278.
16. Tufte, Edward R. (1997). *Visual and Statistical Thinking: Display of Evidence for Making Decisions*. Graphics Press: Cheshire, CT.
17. Wolman, Harold, George Galster, Royce Hanson, et al. (2005). The Fundamental Challenge in Measuring Sprawl: Which Land Should Be Considered? *The Professional Geographer*, 57(1): 94–105.