USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences
Spatial Sciences Institute

SSCI 382L - Principles of Geographic Information Science

Syllabus

Units: 4

Term, Day, Time: Spring, 2017, Lectures: Monday and Wednesday 2:00-3:20 p.m.; Labs: Tuesday 4:00-5:50 p.m. and Friday 2:00-3:50 p.m.

Location: Lectures: VKC 261; Labs: AHF 145A

Instructor: Jennifer N Swift, Ph.D. GISP
Office: AHF B57D
Regular Office Hours: Tuesday 10-11 a.m. and Thursday 1-2 p.m. PT, and by appointment
Contact Info: jswift@usc.edu, 213-740-5841

Laboratory Co-Instructor: Jason Post
Office: AHF B56A
Office Hours: AHF B55D Wednesday and Thursday 1-2 p.m. PT, and by appointment
Contact Info: jpost@usc.edu, 213-821-0466

Library Help: Katharin Peter
Office: VKC B40A
Office Hours: By appointment
Contact Info: klpeter@usc.edu, 213-740-1700 (office)

IT Help: Richard Tsung
Office: AHF 145D
Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)

Course Description

The spatial sciences focus on the various ways in which geography can be used to acquire, represent, organize, analyze, model and visualize information. These views of the world are supported by Geographic Information Systems (GIS) and the related geospatial technologies (GPS, remote sensing systems, etc.) which, in turn, rely on the underlying geographic information science concepts and methods. This much is known from SSCI 301L: Maps and Spatial Reasoning and this particular course (the second in a three-course sequence) seeks to elucidate how these systems and the underlying science provides a gateway to the natural and social sciences and problem-solving in general. The next step is to learn spatial analysis in depth, which is the key to successfully solving many of the critical societal and environmental challenges we face in today's ever changing world.

That said, a large part of this particular course is focused on various kinds of spatial analysis since they constitute the crux of GIS, providing the means of adding value to geographic data obtained from disparate sources and for turning these data into useful information. Numerous examples will be used throughout the course to illustrate how spatial analysis helps us to understand spatial phenomena through expressions of how the natural world works, and the profound influence we have over our environment. The combination of class and laboratory sessions will show how, for example, effective spatial analysis requires an informed and intelligent user in addition to the appropriate computer hardware and software tools**.**

This course is designed to serve several student audiences given its role as a required course in the B.S. in GeoDesign and Minor in Spatial Sciences. Each audience is encouraged to utilize the laboratory experience and team research projects to investigate diverse geospatial resources such as spatial databases, spatial analysis, and 2D and 3D data visualization to advance their own academic and professional goals.

Learning Objectives

Students who excel in SSCI 382L will:

- Collect, clean, organize, store, and assess the quality of spatial data acquired from disparate sources;
- Understand fundamental spatial science concepts in the context of advanced spatial analysis, both 2D and 3D;
- Understand how many global challenges we face today in society and the environment can be addressed through the application of geographic information science using GIS.

Prerequisite(s): SSCI 301L
Co-Requisite (s): None
Concurrent Enrollment: None
Recommended Preparation**:** None

Course Structure

This is a four-credit course comprised of lectures (two per week) and lab (one per week). The lecture sessions are organized into learning modules that build upon core principles of geographic information science by delving into topics including spatial analysis and 3D GIS, and the software systems used to explore these topics. The weekly lab meetings and projects are designed to broaden your practical experience and deepen your understanding of the tools of spatial science inquiry and to enhance your problem-solving skills within the framework of the scientific method. The lecture and lab sessions are designed to complement each other to provide you with sound theoretical reasoning and the technical skills to investigate various physical and social processes. Your weekly laboratory assignments will be graded and returned, and the mid-term and final project will have a laboratory component to them. **It is required that you register for both the lecture and one laboratory session for this course.**

Please note that all course materials and correspondence will be posted on the course Blackboard website. As a registered student you will find this course available for you to access at 10 a.m. PT on the first day of classes**.**

Technological Proficiency and Hardware/Software Required

The computational software and geospatial data required for course assignments will be accessed using computing resources provided by the Spatial Sciences Institute.

Required Readings

The required textbooks for this course are:

- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2015. *Geographic Information Systems and Science*. 4th ed., New York: John Wiley and Sons.
- Mitchell, Andy. 1999. *The Esri Guide to GIS Analysis, Volume 1: Geographic Patterns and Relationships*. Redlands: Esri Press.
- Mitchell, Andy. 2009. *The Esri Guide to GIS Analysis, Volume 2: Spatial Analysis Measurements & Statistics*. Redlands: Esri Press.

The required tasks will be supplemented with the following materials:

- de Smith, Michael J., Michael F. Goodchild, and Paul A. Longley. 2015. Ch. 7. "Network and locational analysis", in *Geospatial Analysis*. 5th ed., Winchelsea, UK: The Winchelsea Press. Available in print and a (free!) web version at www.spatialanalysisonline.com.
- Steinitz, Carl, and Hrishi Ballal. 2015. "Experiments in Geodesign synthesis". Accessed October 20, 2016. http://video.esri.com/watch/4162/experiments-in-geodesign-synthesis.
- Zaliapin, Ilya, and Yahuda Ben-Zion .2016. "A global classification and characterization of earthquake clusters." *Geophysical Journal International* 207:1 608-634.

Description and Assessment of Assignments

Your grade in this class will be determined on the basis of several different assessments:

Class Participation (3%): A class participation grade for the semester will be assigned based on your engagement in class. Students are expected to complete and discuss assigned readings, engage in lecture, share and discuss course assignments, complete and discuss in-class "worksheets," among other forms of active engagement in the course.

Laboratory Assignments (27%): This course includes a laboratory meeting each week to develop technical competency with geospatial software platforms and analytic tools. There will be a total of nine laboratory assignments over the course of the semester.

Projects (20%): Two group projects will be used to practice the techniques explored in theory and in the laboratory assignments. The projects may include primary, and will include secondary data collection. At the completion of each project, you will turn in digital output to demonstrate that you have completed it.

Mid-term Exam (20%): The mid-term exam will consist of multiple-choice, short answer, and simple problem questions. Students will be expected to take the exam at the indicated time.

Final Project (30%) - The final project is an individual capstone report and presentation for this course, and students will be expected to draw upon course lectures, discussions, lab assignments, readings, and outside sources to organize and deliver a self-directed study on a topic of interest utilizing advanced spatial analysis and geospatial technologies. The report is limited to 10 pages (with 12-point font, 1 inch margins, single-spacing for text) and will include one or more maps, tables, and other diagrams as well as a list of references. The presentation will include slides and will be limited to 10 minutes per student.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Class Participation	NA	NA	3
Laboratory Assignments	9	3	27
Projects	2	10	20
Mid-term Examination	1	20	20
Project Components			
Final Project Report	1	20	20
Final Project Presentation	1	10	10
Total	18	-	100 points

Assignment Submission Policy

Assignments will be submitted for grading via Blackboard by the due dates specified in the Course Schedule below.

Additional Policies

Students are expected to attend and participate in every class session and to complete and upload all assignments before the deadlines detailed in the Course Schedule. Late work will be assessed a penalty of 10% per day and zero grades will be assigned for work that is more than seven days late.

Course Schedule

	Topic	Readings and Assignments	Deliverables/Due Dates
Module 1 | Spatial Science Fundamentals			
Week 1 1/9	**Introduction to the Course** Brief introductions coupled with discussions of class goals, lab assignments, projects, and technology.	Longley et al. (2015) Ch. 4, pp. 77-94, Ch. 6, pp. 128-150	
1/11	**Review: The Nature of Geographic Data** Review of core geospatial concepts covered in SSCI 301, including projections and coordinate systems, and use of open source and proprietary GIS.		Complete by 1/13: Lab 1: Review Core Geospatial Concepts and Use of GIS
Week 2 *Monday, 1/16 is University holiday			
1/18	**Geocoding & Georeferencing** Discussion about how to create map features from addresses, place names, and other information with a spatial component, and aligning geographic data such as man-made structures that are missing real-world spatial references.	Longley et al. (2015) Ch. 4, pp. 95-98	Complete by 1/20: Lab 2: Geocoding & Georeferencing Objects to a Geographic Location
Module 2 | Core Geospatial Data Handling Techniques			
Week 3 1/23	**Geographic Uncertainty** Discussion of why uncertainty arises in geographic representation and how to identify sources of uncertainty, including the effects of scale and aggregation.	Longley et al. (2015) Ch. 5, pp. 99-127, Ch. 8, pp. 181-193	
1/25	**Data Quality & Secondary Spatial Data** Discussion about quality assessment of spatial data, and deep dive into core geospatial data sources, their importance in spatial science and the challenges of preparing such datasets for spatial analysis.		Complete by 1/27: Lab 3: Geographic Uncertainty & Data Quality

	Topic	Readings and Assignments	Deliverables/Due Dates
Week 4 1/30 2/1	**GIS Database Management Systems** Discussion about how open source and proprietary spatial databases are built and maintained over time. **Geospatial Data Storage and Analysis** Discussion about collecting, processing, storing and analyzing spatial data, and the computational power required to analyze "big data" or massive quantities of spatial data collected across multiple spatiotemporal scales and targeting diverse audiences.	Longley et al. (2015) Ch.9, pp. 202-216	Complete by 2/3: Lab 4: Developing and maintaining geographic databases
Module 3 | Spatial Analysis			
Week 5 2/6 2/8	**Introduction to GI Analysis** Review of core of spatial analysis techniques and introduction to spatial measurements and statistics, including case studies such as computing watersheds and visibility. **Point Patterns** Discussion of the requirements for a set of events to constitute a spatial point pattern and how to describe such patterns through visualization in graphs and on maps.	Longley et al. (2015) Ch. 13, pp. 290-312, Mitchell (1999) Chs. 1,2, pp. 9-62, Mitchell (2009) Chs. 1,2 pp. 1-70	Complete by 2/10: Lab 5: Point Pattern Analysis: Delineating Viewsheds
Week 6 2/13 2/15	**Introduction to Point Pattern Analysis** Discussion of point pattern spatial analysis techniques. **Point Pattern Analysis in the Real World** Discussion of different statistical methods for analyzing clusters of points.	Mitchell (1999) Chs. 4,5,6, pp. 69-143, Mitchell (1999) Chs. 3,4, pp. 71-190	Complete by 2/17: Lab 6: Point Pattern Analysis: Nearest Neighbor Distances & Cluster Detection
Week 7 2/21* *Monday, 2/20 is University holiday 2/22	**Introduction to Spatial Interpolation** Introduction to spatial data interpolation concepts such as slope and aspect.	Longley et al. (2015) Ch. 13,14, pp. 313-317, 319-328	Complete by 2/24: Lab 7: Spatial Interpolation: Creating 3D Surfaces

	Topic	Readings and Assignments	Deliverables/Due Dates
Week 8 2/27 3/1	**Spatial Interpolation Techniques** Discussion of advanced spatial analysis topics including a trend surface analysis. **Overlay** Discussion of how GIS analysis can be used to analyze the relationships between different features.	Longley et al. (2015) Ch. 13, pp. 300-312, Mitchell (2009) Ch. 5, pp.191-227	Complete by 3/3: Lab 8: Spatial Interpolation: Generate Prediction Surfaces
Week 9 3/6	**Mid-Semester Review** Discussion of core concepts in spatial science, handling spatial data, and spatial analysis**.**		No Lab. Review for Mid-Term
3/8	**Mid-Term Exam** (2:00-3:20 PM)		
3/13-3/17	***Spring Recess***		
Week 10 3/20 3/22	**Network Analysis** Discussion of case studies involving spatial analysis of different types of networks, such as analyzing service areas and closest facilities **Change and Time Series Analysis** Discussion of how what's changed can be mapped to anticipate future condition, decide on a course of action or to evaluate the results of a policy or decision.	de Smith et al. (2015), Longley et al. (2015) Ch. 14, pp. 319-329, Mitchell (1999) Chs. 6, 7, pp.115-174	Complete by 3/24: Lab 9: Planning Logistics using Network Analysis
Module 3: Group Projects			
Week 11 3/27 3/29	**Group Projects** Overview of content, tasks and deliverables of the three group projects to be completed in Weeks 11 through 15. **Core Geospatial Data** Review and discussion of specific core geospatial datasets of interest to students working in teams to complete a project.	Longley et al. (2015) Ch. 14, pp. 329-338	Complete by 3/31: Group Project 1: Dirty Data Challenge
Week 12 4/3	**Investigating Alternative Landscapes Through GeoDesign** Discussion about how GeoDesign projects, including data collection, processing, and spatial analysis techniques used in GeoDesign practice.	Stienitz and Ballal (2015), Zaliapin and Ben-Zion (2016)	

	Topic	Readings and Assignments	Deliverables/Due Dates
4/5	**Spatial Analysis in Environmental Studies** Discussion of project goals, data needs, spatial analysis decision points and outputs of environmental studies. Students work in teams to complete a project.		Complete by 4/7: Group Project 2: Point Pattern Analysis Proposal
Week 13 4/10	**3D Spatial Data Representation** Discussion about current and emerging technologies for representing 3D spatial data.		
4/12	**3D Spatial Data Analysis** Discussion about large-scale raster analysis to make multi-criteria queries to conduct raster-based studies. Comparison of 3D spatial analysis tools in open source and proprietary systems. Students work in groups to complete a project.		Complete by 4/14: Group Project 2 Deliverables, and Final Project: Spatial Interpolation Proposal
Week 14 4/17	**The GeoWeb & Mobile User** Discussion about how parts of a GIS can be distributed, how geolibraries and geoportals are created and utilized, and the impact of global integration of mobile devices into our world that supports GIS.	Longley et al. (2015) Ch. 10, pp. 217-236	
4/19	**Overview: Spatial Modeling, Programming in GIS & Societal Challenges** Overview of SSCI 483 topics, including spatial modeling techniques, programming in GIS, design methods using GIS, critical GI system project management skills, ethics in spatial science, and the many types of challenges we can tackle using spatial science concepts. Students present group projects.		Complete by 4/21: Complete Final Project Deliverables
Week 15 4/24*	**Final Projects** Students present Final projects. Complete Final Project spatial analysis and report.	Longley et al. (2015) Ch. 19, pp. 435-437	
4/26 ***Friday, 4/28 is last day of class**	**Final Project Presentations** Students present Final projects.		No Lab. Final Project Presentations
5/8	**Final Project** (2:00-4:00p.m.)		Final Project Report

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://policy.usc.edu/student/scampus/part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Relationship and Sexual Violence Prevention Services* http://engemannshc.usc.edu/rsvp/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Academic Accommodations

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP and it should be delivered to me early in the semester. DSP is located in STU 301 and is open from 8:30am to 5:00pm, Monday through Friday (213-740-0776; study@usc.edu).