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, 2019, Lectures: Mondays and Wednesdays 2:00-3:20 p.m.; Labs: Tuesdays 4:00-5:50 p.m. and Fridays 10:00-11:50 a.m.

Location: Lectures: VKC 154; Labs: AHF 145A

Instructor: Su Jin Lee, Ph.D., GISP
Office: AHF B55K
Office Hours: Tuesdays 2:00-3:00 p.m. and Thursdays 1:00-2:00 p.m. Also available most days and times by appointment via email.
Contact Info: sujinlee@usc.edu, 213-740-2845 (office)

Laboratory Co-Instructor: Leilei Duan, Ph.D
Office: AHF B57E
Office Hours: Wednesdays 9:00-10:00 a.m. and Thursdays 1:00-2:00 p.m.
Contact Info: leileidu@usc.edu, 213-740-0736 (office)

Library Help: Andy Rutkowski
Office: VKC B36B
Office Hours: Tuesdays 10:00 a.m.-12:00 p.m. and Thursdays 4:30-5:30 p.m.
Contact Info: arutkows@usc.edu, 213-740-6390 (office), http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF B57E
Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)

Course Scope and Purpose

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 (GISs) and the related geospatial technologies (GPS, remote sensing, 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 provide 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 and actionable information. Numerous examples will be used throughout the course to illustrate how spatial analysis helps you to understand spatial phenomena through expressions of how the natural world works, and the profound influence we have on 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, and as an elective in the Human Security and Geospatial Intelligence Minor. Each audience is encouraged to utilize the laboratory experience and research projects to investigate diverse geospatial resources such as spatial databases, spatial analysis, and space-time modeling to advance their own academic and professional goals.

Learning Outcomes

On completion of this course, students should be able to:

- Collect, clean, organize, store, and assess the quality of spatial data acquired from disparate sources;
- Discuss and distinguish the fundamental spatial science concepts in the context of advanced spatial analysis;
- Explain the central role of spatial autocorrelation in spatial analysis and how computational models represent space-time dynamics;
- Conduct spatial analysis utilizing various forms of spatial data and methodologies such as, but not limited to: discrete entities, continuous fields, and grids;
- Perform interpolations using deterministic and geostatistical methods, and ascertain the best approach to solve a given problem;
- Organize, design, and execute a spatial analysis that addresses a particular societal or environmental challenge through the application of geographic information science.

Prerequisite(s): SSCI 301L
Co-Requisite(s): 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 the core principles of geographic information science, spatial analysis and the use of several software systems to explore these topics. The weekly lab meetings and the final project 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 reports will be graded and returned, and the mid-term and final exams will have laboratory components attached 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 10:00 a.m. 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 textbook for this course is:

- Burrough, Peter A, Rachael A. McDonnell, and Christopher D. Lloyd 2015. *Principles of Geographic Information Systems*. 3rd ed. New York: Oxford.

The required texts will be supplemented with the following materials:

- Aubrya, Thierry, Luis Luis, and Luca A. Dimuccio. 2012. "Nature vs. culture: Present-day spatial distribution and preservation of open-air rock art in the Coa and Douro River Valleys (Portugal)". *Journal of Archaeological Science* 39, no. 4 (April): 848-866.
- de Smith, Michael J., Michael F. Goodchild and Paul A. Longley. 2018. *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools*, 6th Edition. Winchelsea, UK: The Winchelsea Press. Available in both print and a (free!) web version at www.spatialanalysisonline.com.
- Goswami, Rajasmita, Simon H. Brocklehurst, and Neil C. Mitchell. 2012. "Erosion of a tectonically uplifting coastal landscape, NE Sicily, Italy." *Geomorphology* 171-172: 114-126.
- Kang, Bin, Daming He, Lisa Perrett, Hongyuan Wang, Wenxian Hu, Weide Deng, and Yunfei Wu. 2009. "Fish and fisheries in the Upper Mekong: Current assessment of the

fish community, threats, and conservation." *Reviews in Fish Biology and Fisheries* 19, no. 4 (April): 465-480.

Description and Assessment of Assignments

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

Writing Assignments – 3 worth a total of 15 points. Students will be expected to complete three written assignments focused on assigned readings while including reflections on lecture material and in-class activities.

Laboratory Reports – 10 worth a total of 30 points. This course includes a laboratory meeting each week to develop technical competency with geospatial software platforms and analytic tools. There will be 10 laboratory reports over the course of the semester.

Mid-term Examination – 1 worth 15 points. The mid-term examination will consist of multiple-choice, short answer, and essay questions. Students will be expected to take the exam at the indicated time.

Final Project – 1 worth 20 points. The final project is an individual capstone report (15 points) and presentation (5 points) for this course. Students will be expected to draw upon course lectures, discussions, lab reports, readings, and outside sources to organize and deliver a self-directed study on a topic of interest in utilizing advanced spatial analysis and methods. 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.

Final Examination – 1 worth 20 points. The final examination will consist of multiple-choice, short answer, and essay questions. Students will be expected to take the exam at the indicated time.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Writing Assignments	3	5	15
Laboratory Reports	10	3	30
Mid-term Examination	1	15	15
Final Examination	1	20	20
Final Project Components			
Final Project Report	1	15	15
Final Project Presentation	1	5	5
Total	17	-	100 points

Assignment Submission Policy

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

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

	Topics	Readings and Assignments	Deliverables/ Due Dates
Week 1 1/7	**Introduction to Class** Introductions coupled with discussion of class goals, lab assignments, projects, and technology options.		No deliverables
1/9	**Data and Statistical Methods** Introduction of summarizing numerical data, the histogram representing the distribution of data values, and the relationships between variables.	Burrough et al. (2015) Ch. 6, pp. 111-117, 120-121 Writing Assignment 1	
Week 2 1/14 is a university holiday	Martin Luther King Day (No Class)		
1/16	**Spatial Dependence, Spatial Autocorrelation, and Point Pattern Analysis** Introduction to the concept of spatial dependence, the first law of geography, and various ways of analyzing point patterns.	Burrough et al. (2015) Ch. 6, pp. 117-119, 121-125	
Week 3 1/21	**Discrete Entities and operations** Introduction of the discrete entities and various operations.	Burrough et al. (2015) Ch. 7, pp. 127-134	Complete within 48 hours after your lab: Lab 1: Estimating clustering using spatial autocorrelation
1/23	**Deriving New Attributes** Introduction of how to computing new attributes or reclassifying attributes.	Burrough et al. (2015) Ch. 7, pp. 134-145	Complete by 1/23: Writing Assignment 1: Introduction to spatial data and spatial analysis techniques

	Topics	Readings and Assignments	Deliverables/ Due Dates
Week 4 1/28	**Continuous Fields** Introduction of the concepts of the continuous fields.	Burrough et al. (2015) Ch. 10, pp.201-202	Complete within 48 hours after your lab: Lab 2: Point patterns analysis
1/30	**Basic Operations for Spatial Analysis** Introduction of map algebra, cartographic modeling, point operations, and spatial operations.	Burrough et al. (2015) Ch. 10, pp.202-203	
Week 5 2/4	**Interpolation and Spatial Filtering** Introduction of the spatial operations and spatial filtering using gridded data.	Burrough et al. (2015) Ch. 10, pp.203-207	Complete within 48 hours after your lab: Lab 3: Creating entities using operations
2/6	**Filtering Case Studies** Using case studies, introducing how spatial filters can modify the characteristics of raster data.	Burrough et al. (2015) Ch. 10, pp.207-218	
Week 6 2/11	**Deriving a Drainage Network from the Continuous Surface** Introduction of the concept of the mathematically continuous surface and calculation the mathematical derivatives at any point (e.g. Drainage network)	Burrough et al. (2015) Ch. 10, pp.219-225	Complete within 48 hours after your lab: Lab 4: Understanding surface using fundamental terrain parameters
2/13	**Applications of the Continuous Surfaces** Introduction of how various fields implement the continuous surfaces.	Burrough et al. (2015) Ch. 10, pp.226-230 Writing Assignment 2	
Week 7 2/18 is a university holiday	Presidents Day (No Class)		Complete within 48 hours after your lab: Lab 5: Delineating a drainage network
2/20	**Spatial Interpolation** Introduction to why and when spatial interpolation is important	Burrough et al. (2015) Ch. 8, pp. 147-151	

	Topics	Readings and Assignments	Deliverables/ Due Dates
Week 8 2/25	**Global and Local Interpolation** Introduction of two groups of the interpolation methods.	Burrough et al. (2015) Ch. 8, pp. 147-159	Complete within 48 hours after your lab: Lab 6: Generating interpolated surfaces using different kinds of sampling methods
2/27	**A Comparison of Interpolation Techniques** Introduction to the cross-validation method to assess the performance of alternative interpolation methods.	Burrough et al. (2015) Ch. 8, pp. 160-169	Complete by 2/27: Writing Assignment 2: Applications of the continuous surface
Week 9 3/4	Mid-term Examination Review		No lab
3/6	Mid-term Examination		
3/11*	*3/11-3/15 is *Spring Recess*		
Week 10 3/18	**Variogram Models** Introduction of geostatistical interpolation methods.		Complete within 48 hours after your lab: Lab 7: Comparison of interpolation techniques
3/20	**Ordinary Kriging** Introduction of the ordinary kriging interpolation method.	Burrough et al. (2015) Ch. 9, pp. 172-181	
Week 11 3/25	**Other Forms of Kriging** Introduction of various Kriging interpolation methods.	Burrough et al. (2015) Ch. 9, pp. 181-199 Complete by 3/20: Writing Assignment 2	Complete within 48 hours after your lab: Lab 8: Understanding variograms
3/27	**Methods of Representing Elevation** Introduction to the regular grid and triangulated irregular networks to build digital elevation models.	Burrough et al. (2015) Ch. 11, pp.231-235	
Week 12 4/1	**Sources of DEMs** Exploring various sources of DEMs	Burrough et al. (2015) Ch. 11, pp.235-242 Writing Assignment 3	Complete within 48 hours after your lab: Lab 9: Evaluating the results of the kriging methods
4/3	**Applications of Digital Elevation Models** Exploration of different applications of digital elevation models.	Burrough et al. (2015) Ch. 11, pp.242-249 Goswami et al. (2012) Kang et al. (2009) Aubrya et al. (2012)	

	Topics	Readings and Assignments	Deliverables/ Due Dates
Week 13 4/8	**Computational Models and Space-time Modeling** Exploring the various components and inputs to computational models and representing space-time processes in space-time modeling.	Burrough et al. (2015) Ch. 12, pp.251-255	
4/10	**GIS-based Computational modeling and Errors in Spatio-temporal Modeling** Understanding how space-time modeling uses GIS and how errors affect resulting outputs.	Burrough et al. (2015) Ch. 12, pp.255-266	Complete by 3/20: Writing Assignment 3: Discussion of various sources of DEMs and the applications DEMs.
Week 14 4/15	**Fuzzy and Uncertainty** Understanding how imprecise fuzzy ideas are used in spatial data analysis.	Burrough et al. (2015) Ch. 13, pp.267-272	Complete within 48 hours after your lab: Lab 10: Exploring the image time series with IDRISI Earth Trends Modeler
4/17	**Fuzzy Classification** Understanding the process of fuzzy classification.	Burrough et al. (2015) Ch. 13, pp.272-286	
Week 15 4/22	**Final Project Presentations** Students present final projects.	Final Project Presentation	Final project presentation slides: Complete no later than Monday, 4/22, 9:00 am
4/24	**Final Project** Students complete final spatial analysis projects and submit the reports.	Final Project Report	Final project report: Complete no later than Friday, 4/26, 5:00 pm
Exam Week 5/1	**Final Examination** (Wednesday, 5/1, 2:00-4:00 pm)		

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 Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/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.

Support Systems

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255 – 24/7 on call
www.suicidepreventionlifeline.org
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support – (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs – (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

Student Support and Advocacy – (213) 821-4710
studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.