

## **SSCI 382L - Principles of Geographic Information Science**

### *Syllabus*

**Units:** 4

**Term Day Time:** Spring 2020, 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 258; Labs: AHF 145A

**Instructor:** Su Jin Lee, Ph.D., GISP

**Office:** AHF B55K

**Office Hours:** Mondays 12:00-1:00 p.m. and Wednesdays 12:30-1:30 p.m. Also available most days and times by appointment via email.

**Contact Info:** [sujinlee@usc.edu](mailto:sujinlee@usc.edu), 213-740-2845 (office)

**Laboratory Co-Instructor:** Lourdes Johanna Avelar, M.A.

**Office:** AHF B55

**Office Hours:** Mondays 4:00-5:00 p.m. and Tuesdays 3:00-4:00 p.m. Also available most days and times by appointment via email.

**Contact Info:** [avelarpo@usc.edu](mailto:avelarpo@usc.edu)

**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](mailto: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](mailto: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 in GIS and Sustainability Science, 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, deepen your understanding of the tools of spatial science inquiry and 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](http://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.

## Schedule

	Topics	Readings and Assignments	Deliverables/ Due Dates
<b>Week 1</b> 1/13	<b>Introduction to Class</b> Introductions coupled with discussion of class goals, lab assignments, projects, and technology options.		
1/15	<b>Geographic Data</b> 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	
<b>Week 2</b> 1/20	*Monday, 1/20 is university holiday		
1/22	<b>Spatial Statistics</b> Introduction to the concept of spatial statistics and its applications.	Burrough et al. (2015) Ch. 6, pp. 117-119, 121-125	
<b>Week 3</b> 1/27	<b>Geographic Distribution and Point Pattern Analysis</b> Introduction of various geographic distributions and point pattern analysis	Burrough et al. (2015) Ch. 6, pp. 117-119, 121-125	Complete within 48 hours after your lab: Lab 1: Estimating clustering using spatial autocorrelation
1/29	<b>Hypothesis Testing and Spatial Autocorrelation</b> Introduction of IRP/CSR and a Monte Carlo test	Burrough et al. (2015) Ch. 6	Complete by 1/29: Writing Assignment 1: Introduction to spatial data and spatial analysis techniques
<b>Week 4</b> 2/3	<b>Regression Analysis</b> Introduction of OLS	Burrough et al. (2015) Ch. 6, pp. 114-117	Complete within 48 hours after your lab: Lab 2: Point patterns analysis
2/5	<b>Geographically Weighted Regression</b> Introduction of how to explain local variations.	Burrough et al. (2015) Ch. 6, pp. 120-121	

	Topics	Readings and Assignments	Deliverables/ Due Dates
<b>Week 5</b> 2/10	<b>Entities and Proximity</b> Introduction of the discrete entities and proximity analysis.	Burrough et al. (2015) Ch. 7, pp. 127-134	Complete within 48 hours after your lab: Lab 3: Creating entities using operations
2/12	<b>Operations and Deriving New Attributes</b> Introduction of various operations and how to computing new attributes or reclassifying attributes.	Burrough et al. (2015) Ch. 7, pp. 134-145	
<b>Week 6</b> 2/17	*Monday, 2/17 is university holiday		
2/19	<b>Continuous Fields</b> Introduction of the concepts of the continuous fields.	Burrough et al. (2015) Ch. 10, pp.201-207	Complete within 48 hours after your lab: Lab 4: Understanding surface using fundamental terrain parameters
<b>Week 7</b> 2/24	<b>Filtering Case Studies</b> Using case studies, introducing how spatial filters can modify the characteristics of raster data.	Burrough et al. (2015) Ch. 10, pp.207-218	Complete within 48 hours after your lab: Lab 5: Delineating a drainage network
2/26	<b>Delineating the Hydrologic Features from the Continuous Surface</b> 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	
<b>Week 8</b> 3/2	<b>Applications of the Continuous Surfaces</b> Introduction of how various fields implement the continuous surfaces.	Burrough et al. (2015) Ch. 10, pp.226-230 Writing Assignment 2	Complete within 48 hours after your lab: Lab 6: Generating interpolated surfaces using different kinds of sampling methods
3/4	<b>Spatial Interpolation</b> Introduction to why and when spatial interpolation is important	Burrough et al. (2015) Ch. 8, pp. 147-151	
<b>Week 9</b> 3/9	Mid-term Examination Review		No lab
3/11	Mid-term Examination		
3/16*	*3/16-3/22 is Spring Recess		

	Topics	Readings and Assignments	Deliverables/ Due Dates
<b>Week 10</b> 3/23	<b>Global and Local Interpolation</b> 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 7: Comparison of interpolation techniques
3/25	<b>A Comparison of Interpolation Techniques</b> 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 3/25: Writing Assignment 2: Applications of the continuous surface
<b>Week 11</b> 3/30	<b>Variogram Models and Ordinary Kriging</b> Introduction of geostatistical interpolation methods and the ordinary kriging interpolation method.	Burrough et al. (2015) Ch. 9, pp. 172-181	Complete within 48 hours after your lab: Lab 8: Understanding variograms
4/1	<b>Various Kriging</b> Introduction of various Kriging interpolation methods.	Burrough et al. (2015) Ch. 9, pp. 181-199 Complete by 3/20: Writing Assignment 2	
<b>Week 12</b> 4/6	<b>Final Project Introduction</b>		No lab
4/8	<b>Methods of Representing Elevation and Sources of DEMs</b> Introduction to the regular grid and triangulated irregular networks to build digital elevation models, and Exploring various sources of DEMs	Burrough et al. (2015) Ch. 11, pp.231-242 Writing Assignment 3	
<b>Week 13</b> 4/13	<b>Applications of Digital Elevation Models</b> 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)	Complete within 48 hours after your lab: Lab 9: Evaluating the results of the kriging methods
4/15	<b>Computational Models, GIS-based Computational modeling and Errors in Spatio-temporal Modeling</b> 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.251-266	Complete by 4/15: Writing Assignment 3: Discussion of various sources of DEMs and the applications DEMs.

	Topics	Readings and Assignments	Deliverables/ Due Dates
<b>Week 14</b> 4/20	<b>Fuzzy and Uncertainty</b> Understanding how imprecise fuzzy ideas are used in spatial data analysis. Understanding how space-time modeling uses GIS and how errors affect resulting outputs.	Burrough et al. (2015) Ch. 13, pp.267-286	Complete within 48 hours after your lab: Lab 10: Exploring the image time series with IDRISI Earth Trends Modeler
4/22	Final Examination Review		
<b>Week 15</b> 4/27	<b>Final Project Presentations</b> Students present final projects.	Final Project Presentation	Final project presentation slides: Complete no later than Monday, 4/27, 9:00 am
4/29	<b>Final Project</b> Students complete final spatial analysis projects and submit the reports.	Final Project Report	Final project report: Complete no later than Friday, 5/1, 5:00 pm
<b>5/11</b>	<b>Final Examination on Monday, 5/11, 2:00-4:00 pm</b>		

## 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](http://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, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

### Support Systems:

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*

[studenthealth.usc.edu/counseling](http://studenthealth.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*

[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

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 and Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call*

[studenthealth.usc.edu/sexual-assault](http://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298*

[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help someone affected by 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. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*

[usc-advocate.symlicity.com/care\\_report](http://usc-advocate.symlicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*

[dsp.usc.edu](http://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.