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

SSCI 383L, Geospatial Modeling and Customization

Syllabus

Units: 4

Term – Day – Time: Spring, 2019, Lectures: Mon and Wed 12-1:20 pm PT; Lab: Thu 2-3:50 pm PT

Location: Lectures AHF 145D; Lab: AHF 145A

Instructor: Jennifer N Swift, Ph.D. GISP
Office: AHF B57D
Regular Office Hours: Mondays and Wednesdays 2 p.m.-3 p.m. PT, also available most days and times by appointment via email.
Contact Info: jswift@usc.edu, 213-740-5841 (office)

Laboratory Co-Instructor: LeiLei Duan
Office: B57E
Regular Office Hours: Mondays 3:30 p.m. – 4:30 p.m, also available most days and times by appointment via email.
Contact Info: leileidu@usc.edu, 213-740-0739 (office)

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

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

Course Scope and Purpose

The spatial sciences now require professionals with GIS modeling and customization skills, an essential part of the career portfolio. This course provides the fundamentals of spatial modeling, and how to use GIS customization and programming, or scripting, to streamline complex spatial analysis and modeling workflows. An understanding of GIS modeling and how to create and implement customized tools is needed to successfully solve many of the critical societal and environmental challenges we face in today's ever-changing world. Learning to program facilitates understanding of one's use of GIS as well as how to interact with others who use GIS software. Familiarity with a GIS programming language and how it is implemented also provides in-depth insight into how other programmers create and use these tools. Helping you become comfortable with creating, coding and documenting GIS modeling workflows is a fundamental goal of this course.

Numerous examples will be used throughout the course to illustrate how spatial modeling helps us 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 modeling combined with creative coding 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 research projects to investigate diverse geospatial resources such as spatial modeling, computer programming, remotely sensed imagery, and 2D and 3D data visualization to advance their own academic and professional goals.

Learning Objectives

Students who excel in SSCI 383L will:

- Understand fundamental spatial science concepts in the context of spatial modeling;
- Explain how spatial models can be used to solve and understand real-world problems from an interdisciplinary viewpoint;
- Program small-scale GIS-based models in Python, integrated within ArcGIS or some other geospatial software ecosystem;
- Streamline complex workflows using GIS customization techniques;
- Describe how many of the complex global challenges we face today can be addressed through the combination of spatial modeling and customization using GIS.

Prerequisite(s): SSCI 301L, SSCI 382L or Instructor Permission
Co-Requisite (s): None
Concurrent Enrollment: None
Recommended Preparation: None

Course Structure

This is a four-credit course comprised of combined lectures (two per week) and labs (one per week). The combined lecture and lab sessions are organized into learning modules that build upon core principles of geographic information science by delving into topics including spatial modeling and GIS customization, and the software systems used to explore these topics. The weekly meetings and projects are designed to broaden your practical experience and deepen your understanding of the concepts and 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 provide you with sound theoretical reasoning and the technical skills to investigate various physical and social processes. Your weekly assignments will be graded and returned, and the mid-term and both projects will have a laboratory component to them.

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 Requirements

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

Required Readings and Supplementary Materials

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.

The required tasks will be supplemented with the following materials:

- Miller, Harvey, and Michael F. Goodchild. 2015. “Data Driven Geography.” *GeoJournal* 80, no. 4 (October): 449-461.
- Li, Linna. 2017. “Spatial Data Uncertainty.” *The Geographic Information Science & Technology Body of Knowledge* (4th Quarter 2017 Edition), John P. Wilson (ed).
- Padmanabhan, Anand, Shaowen Wang, Guofeng Cao, Myunghwa Hwang, Zhenhua Zhang, Yizhao Gao, Kiumars Soltani, and Yan Liu. 2014. “FluMapper: A CyberGIS Application for Interactive Analysis of Massive Location-Based Social Media.” *Concurrency and Computation Practice and Experience* 26, no. 13 (September): 2253–2265.
- Steinitz, Carl. 2012. “Chapter 9: Geodesign When Knowing the Rules.” In *A Framework for Geodesign: Changing Geography by Design*, 139 - 178. Redlands, CA: Esri Press.
- Tong, Daoqin, and Alan T. Murray. 2012. “Spatial Optimization in Geography.” *Annals of the Association of American Geographers* 102, no. 6 (June): 1290-1309.
- Zent, Christopher. 2018. ArcGIS Pro SDK for .NET: “An introduction to Add-Ins and Configurations.” Technical workshop. In *Proceedings of the 2018 Esri User Conference*.

In addition, two Lynda.com courses are supplied with this course:

- Marini, Joe. 2018. Learning Python.
- Pierson, Lillian, 2018. Python for Data Science Essential Training.

Description and Assessment of Assignments

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

Assignments (15%): Students will be expected to complete three assignments focused on assigned readings, engagement in lectures, sharing and discussion of course assignments, and in-class "worksheets," among other forms of active engagement in the course.

Laboratory Assignments (30%): This course includes a laboratory component each week to develop technical competency with geospatial software platforms and analytic tools. There will be a total of ten laboratory assignments over the course of the semester.

Mid-term Exam (15%): 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.

Individual Project (20%) - The individual project is a capstone proposal and report 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 spatial modeling and geospatial technologies. The proposal will include a brief description of the spatial question(s) you would like to ask or the spatial problem you would like to solve and briefly how you plan to solve it. The report is limited to 15 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.

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

Grading Breakdown

Assessment	Number	Points Each	Total Points
Assignments	3	5	15
Laboratory Assignments	10	3	30
Mid-term Examination	1	15	15
Final Examination	1	20	20
Individual Project Components			
Individual Project Proposal	1	5	5
Individual Project Report	1	15	15
Total	17	-	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.

Schedule

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 1 1/7 1/9	**Introduction to the Course** Brief introductions coupled with discussions of class goals, lab assignments, projects, and technologies. Review of basic concepts covered in SSCI 301, including geodesy, projections, scale, cartography, and geocoding. **Maps, Spatial Reasoning & Geographic Information Science Review** Review of fundamental concepts covered in SSCI 382, including spatial analysis operations, computational models, space-time modeling, fuzzy classification and uncertainty.	Longley et al. (2015) Ch. 2, pp. 33-53, Ch. 4, pp. 77-98, Ch. 11, pp. 237-265, Ch. 13, pp. 290-317, Li (2017) Assignment 1	Complete by 1/16: Assignment 1: Recap: Maps, Spatial Reasoning & Geographic Information Science
Week 2 1/14 1/16	**Core Concepts of Spatial Modeling** Introduction to the fundamental concepts of spatial modeling. **Types of Models** Discussion of the different types of spatial models and why we use them, including linear regression models and geographically weighted regression (GWR).	Longley et al. (2015) Ch. 14, pp. 326-337, Ch. 15, pp. 339-343 Assignment 2	Complete by 1/23: Assignment 2: Comparison of different types of spatial models
Week 3 1/21 is a University holiday 1/23	**Cartographic Modeling** Exploration of 2D spatial modeling in the context of geographic information systems and remote sensing using software that supports modeling.	Longley et al. (2015) Ch. 15, pp. 344-345 & 349-351 Lab 1	Complete by 1/30: Lab 1: Introduction to cartographic spatial modeling

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 4 1/28 1/30	**3D Visualization** Investigation of core concepts in creating 3D geographic representations of the real world to facilitate understanding our world. **3D Modeling for Design** Introduction to building 3D models for design applications, such as urban, suburban and rural communities.	Longley et al. (2015) Ch. 12, pp. 266-276 Lab 2	Complete by 2/6: Lab 2: Introduction to 3D Visualization using Esri City Engine
Week 5 2/4 2/6	**3D Modeling Fundamentals** Visualization using different projections, 3D libraries, and materials application and texture mapping. **3D Modeling in GIS** Creating and editing 3D GIS data, 3D data storage, and exchanging 3D data between different software.	Longley et al. (2015) Ch. 12, pp. 277-288 Lab 3	Complete by 2/13: Lab 3: 3D Modeling in GIS using Esri City Engine
Week 6 2/11 2/13	**3D Spatial Analysis** Introduction to methods to quantitatively analyze the spatial distribution of real and simulated objects within 3D space. **3D Model Integration** Simulating urban settings and creating high-resolution 3D renderings for presentations.	Longley et al. (2015) Ch. 14, pp. 319-326 Individual Project Proposal and Report Instructions Lab 4	Complete by 2/20: Lab 4: 3D Spatial Analysis using Esri City Engine Complete by 3/25: Individual Project Proposal
Week 7 2/18 is a University holiday 2/20	**Agent-Based Modeling** Introduction to the fundamental concepts of agent-based modeling.	Longley et al. (2015) Ch. 15, pp. 346-348 & 351-356, Steinitz (2012) Ch. 9, pp. 150-178 Lab 5	Complete by 2/27: Lab 5: Introduction to agent-based modeling
Week 8 2/25	**Spatial Decision Support** Introduction to methods for developing decision models that can resolve resource allocation decisions, and scenario-based planning for sustainable ecosystem development.	Longley et al. (2015) Ch. 17, pp. 381-409, Steinitz (2012) Ch. 9, pp. 140-149 Lab 6	Complete by 3/4: Lab 6: Collaborative spatial problem solving in interdisciplinary research

	Topics	Readings and Assignments	Deliverables/Due Dates
2/27	**Collaborative Spatial Problem Solving** Exploration of creating and analyzing alternative planning scenarios for informed decision making in spatial studies.		
Week 9 3/4	**Mid-Semester Review**		No Lab. Review for Mid-Term
3/6	**Mid-Term Exam**		
Week 10 3/18 3/20	**Introduction to GIS Customization** Introduction to customizing GIS applications to streamline spatial analyses, models and workflows. **Types of Customizations** Exploration of different proprietary and open source options for developing GIS applications, including use of data portals and other web resources.	Longley et al. (2015) Ch. 6, pp. 131-134, Law and Collins (2016) Ch. 5, pp. 181-224	Complete by 3/27: Assignment 3: Investigation of options for customizing GIS applications
Week 11 3/25 3/27	**Fundamentals of Programming** Introduction to programming in Python in geographic information science and systems. **Programming Tools for GIS** Exploration of Jupyter Notebooks and Python to create and share code, equations, visualizations, and programming documentation.	Marini (2018), Pierson (2018) Lab 7	Complete by 4/3: Lab 7: Introduction to Python and Jupyter Notebooks for spatial science problem-solving in GIS
Week 12 4/1 4/3	**GIS Automation and Customization** Introduction to spatial modeling methods using Esri ArcGIS to process spatial data to handle important social, economic, and environmental challenges faced today and in the future. **Open Source Automation and Customization** Exploration of open source GIS programing options for developing automated and customized solutions, such as Whitebox GAT, GRASS and QGIS.	Zent (2018), Padmanabhan et al. (2014) Lab 8	Complete by 4/10: Lab 8: Introduction to programming and customization using open source GIS tools

Week 13 4/8 4/10	**Extending GIS Through Programming** Introduction to GIS programming that can extend the software to bundle spatial analyses and models into convenient tools. **Wrapping Models in GIS Add-Ins** Exploration of how programming can enhance development of functionality add-ins in geographic information systems.	Longley et al. (2015) Ch. 6, pp. 135-147 Lab 9	Complete by 4/17: Lab 9: Designing Python and Esri Modelbuilder Components for Final Individual Projects
Week 14 4/15 4/17	**Portals** Overview of geospatial web portals, from setup and design, to data collection, formatting, archiving, and dissemination. **Web Services** Overview of different data formats that are often used in geospatial Web services to transport geospatial feature information between Web services and clients.	Longley et al. (2015) Ch. 10, pp. 217-235, Miller and Goodchild (2015) Lab 10	Complete by 4/22: Lab 10: Demonstration of programmatic use of geospatial web maps and web services
Week 15 4/22* 4/24 *Friday, 4/26 is last day of class	**Individual Projects** Students work on individual projects. Complete individual spatial modeling project and report. **Final Individual Reports** Students complete individual project reports.		Complete Individual Project Lab Work: 4/24 Complete by 4/26: Individual Project Reports. All projects must be submitted no later than 5:00 PM PT on 4/26
Exam Week 5/1-5/8	**Final Examination**		Final Examination: Friday, May 3, 11 a.m. – 1 p.m. PT

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.

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link https://libraries.usc.edu/. Also, the USC Libraries have many important resources available for distance students through the link: https://libraries.usc.edu/faculty-students/distance-learners. These include instructional videos, remote access to university resources, and other key contact information for distance students.