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, 2018, 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
Office Hours: Mon and Wed 10-11 am PT, also available most days and times by appointment via email.
Contact Info: jswift@usc.edu, 213-740-5841 (office)

Laboratory Co-Instructor: Su Jin Lee, Ph.D. GISP
Office: AHF B55K
Office Hours: Mon 11 am-12 pm PT and Tues 2-3 pm PT, also available most days and times by appointment via email.
Contact Info: sujinlee@usc.edu, 213-740-2845 (office)

Library Help: Andy Rutkowski
Office: VKC Library 36B
Office Hours: Tue 10 am-12 pm PT and Thu 4:30-5:30 pm PT
Contact Info: arutkows@usc.edu, 213-740-6390 (office), http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF 146
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:

- iCode Academy. 2017. *Python Programming: Your Step By Step Guide To Easily Learn Python in 7 Days*. North Charleston, SC: CreateSpace Independent Publishing Platform.
- 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.
- Toms, Silas. 2015. *ArcPy and ArcGIS: Geospatial Analysis with Python.* Birmingham, UK: Packt Publishing.

The required tasks will be supplemented with the following materials:

- Law, Michael, and Amy Collins. 2016. "Chapter 5: Facilitating Workflows." In *Getting to Know ArcGIS Pro*, 181-224. Redlands, CA: Esri Press.
- Miller, Harvey, and Michael F. Goodchild. 2015. "Data Driven Geography." *GeoJournal* 80, no. 4 (October): 449-461.
- 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.
- Rigol-Sanchez, Juan P., Neil Stuart, and Antonio Pulido-Bosch. 2015. "ArcGeomorphometry: A toolbox for Geomorphometric Characterization of DEMs in the ArcGIS Environment." *Computers & Geosciences* 85, Part A (December): 155-163.

- 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.

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 an 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 spatial modeling and geospatial technologies. 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. The presentation will include slides and will be limited to 10 minutes per student.

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 Report	1	15	15
Individual 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 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 1/8	**Introduction to the Course** Brief introductions coupled with discussions of class goals, lab assignments, projects, and technologies.		
1/10	**Introduction to Geographic Databases** Introduction to the role of database management in geographic information systems, use of Structured Query Language (SQL), and key geographic database types and functions.	Longley et al. (2015) Ch. 6, pp. 128-151, Ch. 9, pp. 194-204	Complete by 1/16: Assignment 1: Introduction to object oriented spatial databases
Week 2 1/15 is a University holiday			
1/17	**Geographic Databases: Semantics and Ontology** Examination of the primacy of words and the logic of language as applied to GIS data and geographic database design, key techniques for creating topology and indexing, and multiuser editing and versioning.	Longley et al. (2015) Ch. 9, pp. 205-215	Complete by 1/22: Lab 1: Introduction to geographic database design, spatial queries, and multi-user databases
Week 3 1/22	**Geocoding** Exploration of the problems associated with place-names, street addresses and other human systems and how to define real-world locations.	Longley et al. (2015) Ch. 4, pp. 77-98	Complete by 1/29: Lab 2: Geocoding and georeferening spatial data in GIS
1/24	**Georeferening** Introduction to georeferencing, geotagging and georegistration using vector and raster spatial data models.		

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 4 1/29 1/31	**Network Analysis** Introduction to the network data model, the primary types of networks and network analysis. **Optimization** Analysis of spatial decision support and methods of statistical inference applied to geographic data and optimization of network connectivity.	Longley et al. (2015) Ch. 7, pp. 152-172, Ch. 14, pp. 332-337, Tong and Murray (2012)	Complete by 2/5: Assignment 2: Investigation of different types of networks and network analysis methods
Week 5 2/5 2/7	**3D Visualization** Investigation of core concepts in creating 3D geographic representations of the real world to facilitate understanding our world. **3D Spatial Analysis** Introduction to methods to quantitatively analyze the spatial distribution of real and simulated objects within 3D space.	Longley et al. (2015) Ch. 10, pp. 217-235, Ch. 12, pp. 266-288	Complete by 2/12: Lab 3: 3D Visualization and spatial analysis techniques using Esri ArcGIS Pro
Week 6 2/12 2/14	**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	Complete by 2/20: Assignment 3: Comparison of different types of spatial models
Week 7 2/19 is a University holiday 2/21	**Spatial Modeling in GIS** Exploration of 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	Complete by 2/26: Lab 4: Introduction to dynamic spatial modeling and decision support using IDRISI TerrSet
Week 8 2/26	**Agent-Based Modeling** Introduction to the fundamental concepts of agent-based modeling.	Longley et al. (2015) Ch. 15, pp. 346-356, Steinitz (2012) Ch. 9, pp. 150-178	Complete by 3/5: Lab 5: Spatial decision modeling to predict land cover change using IDRISI TerrSet

	Topics	Readings and Assignments	Deliverables/Due Dates
2/28	**Spatial Decision Making** Introduction to methods for developing decision models that can resolve resource allocation decisions.		
Week 9 3/5	**Mid-Semester Review**		No Lab. Review for Mid-Term
3/7	**Mid-Term Exam**		
Week 10 3/19 3/21	**Spatial Modeling and Decision Support** Introduction to scenario-based planning for sustainable ecosystem development. **Collaborative Spatial Problem Solving** Exploration of creating and analyzing alternative planning scenarios for informed decision making in spatial studies.	Longley et al. (2015) Ch. 17, pp. 381-409, Steinitz (2012) Ch. 9, pp. 140-149	Complete by 3/26: Lab 6: Collaborative spatial problem solving in interdisciplinary research using GeoPlanner
Week 11 3/26 3/28	**Fundamentals of Programming for GIS** Introduction to programming in Python in geographic information science and systems. **GIS Automation and Customization** Introduction to different techniques used in GIS application development to streamline spatial analyses, models and workflows.	iCode Academy (2017), Law and Collins (2016) Ch. 5, pp. 181-224, Toms (2015) Ch. 3, pp. 41-59	Complete by 4/2: Lab 7: Introduction to Python for spatial modeling in GIS
Week 12 4/2 4/4	**Wrapping Models in GIS Add-Ins** Exploration of how programming can enhance development of functionality add-ins in geographic information systems. **Extending GIS Through Programming** Introduction to geographic information system programming that can extend the software to bundle spatial analyses and models into convenient tools.	Toms (2015) Ch. 4,5, pp. 61-93, Rigol-Sanchez et al. (2015)	Complete by 4/9: Lab 8: Using Python/Numpy and ArcGIS to extract land surface variables and features from DEMs
Week 13 4/9 4/11	**Open Source Programming and Customization** Exploration of open source GIS programing and customization options. **Spatial Modeling Using Big Data** Introduction to spatial modeling methods to process big spatial data to handle important social, economic, and environmental challenges faced today and in the future.	Padmanabhan et al. (2014)	Complete by 4/18: Lab 9: Introduction to Whitebox GAT remote sensing and change detection techniques

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 14 4/16 4/18	**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)	Complete by 4/23: Lab 10: Demonstration of programmatic use of geospatial web map services
Week 15 4/23* 4/25 ***Friday, 4/27 is last day of class**	**Individual Projects** Students work on individual projects. Complete individual spatial modeling project and report. **Final Individual Presentations & Reports** Students present individual projects.		No Lab Complete by 4/25-4/26: Individual Project Presentations Complete by 4/27: Individual Project Reports. All projects must be submitted no later than 5:00 PM PT on 4/27
Exam Week 5/2-5/9	**Final Examination**		Final Examination: Friday, 5/4, 11 am-1 pm 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" https://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
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

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

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

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

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

Diversity at USC – https://diversity.usc.edu/
Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students