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

SSCI 586, GIS Programming and Customization

Syllabus

Units: 4

Term — Day — Time: Fall 2020, Wednesdays and Fridays, 10:00-11:50 am PT

This class will be offered in a hybrid format. Lectures will be offered in person and streamed for remote access for maximum options and accessibility.

Location: THH 301 & Online

Instructor: Jennifer N Swift, Ph.D. GISP
Office: AHF B57D
Regular Office Hours: Tues and Thurs 5-6 pm PT. Also available most days and times by appointment via email.
Contact Info: jswift@usc.edu, 213-740-5841,
Zoom: Provided via Blackboard

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

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

Course Scope and Purpose

Spatial programming skills are now an essential part of the GIS professional's portfolio. Learning to program facilitates an understanding of one's use of geospatial technologies as well as how to interact with others who use geospatial software. Familiarity with a spatial programming language and how it is implemented also provides deeper insight into how other programmers create and use these tools. Helping you become comfortable with coding and thoroughly documenting novel geospatial tools that can be readily shared with others is the goal of this course.

This course will use modern software tools and information to build and implement customized GIS mapping applications and geoprocessing functions. The students taking this course will have varying levels of prior programming experience and may be new to spatial programming and customization. Essential practical, as well as theoretical concepts of spatial analysis and their translation into geospatial software development and object-oriented programming are covered. In addition, you will learn the Python programming language and its use in developing customized GIS applications directly applicable to your own field of interest. Overall, you will gain a deep and solid foundation for interacting with Esri's ArcGIS ecosystem and Jupyter Notebooks.

By both necessity and design, this course serves several different audiences. This course is an elective for the Geographic Information Science & Technology M.S. and Graduate Certificate Programs, the Human Security and Geospatial Intelligence M.S., and the Geospatial Leadership Graduate Certificate Program. This is a required course for the Spatial Data Science M.S. degree.

Learning Outcomes

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

- Employ different programming languages commonly used in GIS customization, and describe how to use these technologies to expand upon existing GIS software functionality.
- Perform object-oriented programming tasks using various programming languages, such as Python.
- Analyze procedures and interactions for workflows within ArcGIS and Notebooks.
- Program small-scale GIS-based models in Python, integrated within ArcGIS and Notebooks.
- Recognize and employ general software engineering concepts and good programming methods and practices.
- Critically evaluate different methodologies for developing geospatial applications.

Prerequisite(s): None
Co-Requisite(s): None
Recommended Preparation: SSCI 582: Spatial Databases

Harassment, sexual misconduct, interpersonal violence, and stalking are not tolerated by the university. All faculty and most staff are considered Responsible Employees by the university and must forward all information they receive about these types of situations to the Title IX Coordinator. The Title IX Coordinator is responsible for assisting students with supportive accommodations, including academic accommodations, as well as investigating these incidents if the reporting student wants an investigation. The Title IX office is also responsible for coordinating supportive measures for transgender and nonbinary students such as faculty notifications, and more. If you need supportive accommodations you may contact the Title IX Coordinator directly (titleix@usc.edu or 213-821-8298) without sharing any personal information with me. If you would like to speak with a confidential counselor, Relationship and Sexual Violence Prevention Services (RSVP) provides 24/7 confidential support for students (213-740-9355 (WELL); press 0 after hours).

SSI Server and Tech Support

This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software programs. If you are unable to connect to the server or experience any type of technical issue, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu**,** making sure to copy (cc) your instructor on the email.

Workload

This is a four credit, one semester course. Students should expect to spend 10-15 hours per week completing the work in this course.

Required Readings and Supplementary Materials

The required textbooks for this course are:

- Zandbergen, P.A. 2020. Python Scripting for ArcGIS Pro (1st Ed.). Redlands, CA: Esri Press.
- Zandbergen, P.A. 2020. Advanced Python Scripting for ArcGIS Pro (1st Ed.). Redlands, CA: Esri Press.

Supplementary readings will be assigned from various sources including but not limited to:

- Novo, A., Fariñas-Álvarez, N., Martínez-Sánchez, J., González-Jorge, H., & Lorenzo, H. (2020) Automatic Processing of Aerial LiDAR Data to Detect Vegetation Continuity in the Surroundings of Roads. *Remote Sensing, 12*(1677), 1-14.
- Rey, S.J. (2019) PySAL: the first 10 years. *Spatial Economic Analysis, 14*:3, 273-282, DOI: 10.1080/17421772.2019.1593495
- Ricker, B.A., Rickles, P.R., Fagg G.A., & Haklay, M.E. (2020) Tool, toolmaker, and scientist: case study experiences using GIS in interdisciplinary research. *Cartography and Geographic Information Science, 47*(4), 350-366.
- Vance, T.C., Wengren, M., Burger, E., Hernandez, D., Kearns, T., Medina-Lopez, E., Merati, N., O'Brien, K., O'Neil, J., Potemra, J.T., Signell, R.P., & Wilcox, K. (2019) From the Oceans to the Cloud: Opportunities and Challenges for Data, Models, Computation and Workflows. *Frontiers in Marine Science, 6,* 1-18.

You will conduct online library research to find articles that apply specific techniques in an application area of your choice for several of the assignments in this course.

Description and Assessment of Assignments

This course includes a diversity of assessments that allow students to gain knowledge and experience and to show their mastery of the material in a variety of ways. The different types of assessments are described below and their overall point value to are summarized in the following Grading Breakdown section.

Resume Assignment - 1 worth 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Please prepare your resume in the SSI template which will be provided to you. Unless you opt out, your resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is compiled annually and, along with our web presence, is used to promote our programs, and more importantly, your skills, experience and professional aspirations.

Projects - 5 worth a total of 60 points. These assignments require students to complete the basic types of programming projects asked of professional geospatial application developers in real world settings. Prompts will list helpful information, such as Esri and Python tutorials, for becoming familiar with ways that concepts learned in the course are implemented in various geospatial software packages, but the deliverables will be final written summaries of the students' goals, methods, data, and results for each project.

Python Tutorials – 3 worth a total of 6 points. These assignments help students gain familiarity with the Python programming language and different Python coding environments, which they can then use to program their class projects.

Reading and Research Discussions - 3 worth a total of 12 points. These assignments call on students to identify relevant research case studies employing the methodologies and concepts we cover in class and to discuss them with the instructor and their classmates during course meetings and in online discussion forums.

Final Exam - 1 worth 20 points. The final exam will cover material learned throughout the duration of the semester. It will include multiple choice, short answer, and simple problem questions.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Weekly Assignments			
Resume Assignment	2	1	2
Reading and Research Assignments	3	4	12
Tutorials	3	2	6
Projects	5	12	60
Final	1	20	20
Total	14		100

Assignment Submission Policy

Unless otherwise noted, assignments must be submitted via Blackboard by the due dates specified in the Course Schedule below and on the assignment instructions.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points up to FOUR days late. No points will be given for submissions more than FOUR days late.
- No work will be accepted for grading after 5 pm on the last day of classes.

Weekly Course Breakdown

Week	Topic	Assignments	Deliverables: Due Dates
Module 1 | Introduction to GIS Customization and Python			
Week 1 8/24	What is GIS Programming and Customization?	Resume Assignment Reading & Research Discussion (RRD) 1	
Week 2 8/31	Introduction to Programming and the Python Language in GIS	Project 1	Resume Assignment 1: 8/31
Module 2 | Fundamentals of Programming Python in GIS			
Week 3 9/8* 9/7 is a university holiday	Vector Data Manipulation with Python	Project 2	Project 1: 9/8
Week 4 9/14	Raster Data Processing Techniques using Python	Python Tutorial 1	RRD1: 9/14

Week	Topic	Assignments	Deliverables: Due Dates
Module 3 | Programming Spatial Analysis using Python			
Week 5 9/21	Essential Python Geospatial Libraries	Project 3	Project 2: 9/21
Week 6 9/28	Interactive Computational Geospatial Programming	Python Tutorial 2	Python Tutorial 1: 9/28
Week 7 10/5	Cloud-Based Computing Trends in Spatial Computing	RRD2	Python Tutorial 2: 10/9
Module 4 | Python Geospatial Modules and Packages			
Week 8 10/12	Python Scripting for GIS	Project 4	Project 3: 10/12
Week 9 10/19	Integrating Python ArcGIS Packages with Third Party Software	Python Tutorial 3	RRD 2: 10/19
Module 5 | Innovative Geospatial Programming			
Week 10 10/26	Expanding on Python Scripting into Web GIS using Notebooks	Project 5	Project 4: 10/26
Week 11 11/2	Open Source VS Commercial Spatial Programming Tools		Python Tutorial 3: 11/2
Week 12 11/9	Real-Time Spatial Data Access and Manipulation	RRD3	
Week 13 11/16	Future of Spatial Programming and Customization		Resume Assignment 2: 11/16 RRD3: 11/16
Week 14* 11/23 *11/25-11/27 is a university holiday	Final Exam Review		Project 5: 11/23
Final Exam (Asynchronous – Date TBD)			

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
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 Compliance - (213) 821-8298
eeotix.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 that may be specified in applicable laws and governmental regulations.

Reporting Incidents of Bias or Harassment- (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.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
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.

USC Support and Advocacy – (213) 821-4710
campussupport.usc.edu/
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.