SSCI 586 (35711), GIS Programming and Customization

Syllabus

Units: 4

Term — Day — Time: Spring, 2017, Online

Location: Blackboard

Instructor: Wei Yang, PhD
Office: AHF B55A
Regular Office Hours: Wed and Fri 10-11 am PT; also available most days and times by appointment via email.

Contact Info: yang474@usc.edu, 213-740-2835, https://bluejeans.com/4900531065/

GIS Librarian Help: Katharin Peter
Office: VKC B40A
Office Hours: By appointment
Contact Info: kpeter@usc.edu, 213-740-1700 (office)

IT Help: Richard Tsung
Office: AHF 145D
Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)
Course Scope and Purpose
GIS programming skills are now an essential part of the GIS professional’s portfolio. Learning to program facilitates an 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 deeper insight into how other programmers create and use these tools. Helping you become comfortable with coding and thoroughly documenting novel GIS tools that can be readily shared with a crowd is the goal of this course.

This course will provide you with the most up-to-date software tools and information necessary for building and implementing customized GIS mapping applications and geoprocessing functions according to current industry standards. It is assumed that students taking this course are new to programming and have no prior experience. Essential practical as well as theoretical concepts of GIS modeling and its translation into GIS 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.

This course is elective for the Geographic Information Science & Technology M.S. and Graduate Certificate Programs and the Geospatial Leadership Graduate Certificate Program. This is also a graduate level course, so you should expect this class to be intellectually challenging. As graduate students, you are expected to engage with the information you are learning and to explore the heady cauldron of ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. Learning arises from active engagement with the knowledge found in our reading materials and with one another. As in any graduate class, the instructor’s role is that of a guide who keeps you on this path of discovery and you will find that you will learn much from your classmates. The challenge for the instructor is to replicate such an academic experience within the milieu of “online learning.”

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

- Familiarize yourself with different programming languages commonly used in GIS customization, and how to use these technologies to expand upon exiting GIS software functionality.
- Perform object-oriented programming tasks using various programming languages, such as Python.
- Analyze design procedures and interactions for modeling with GIS.
- Program small-scale GIS-based models in Python, integrated within ArcGIS.
- Understand general software engineering concepts and good programming methods and practices.
- Critically evaluate different methodologies for developing applications in GIS.
• Conceptualize, plan, implement, and write up the results of an original GIS programming application, customization, automation and/or extension.

**Prerequisite(s):** None  
**Co-Requisite(s):** None  
**Concurrent Enrollment:** None  
**Recommended Preparation:** SSCI 581: Concepts for Spatial Thinking

**Course Structure**

The course will unfold on a weekly basis. Each week will be focused on a particular aspect of GIS programming and customization. In order to encourage collaboration, the class will be divided into small groups to work on several programming assignments. Group members will share and test each other’s work in brief Discussion threads (online).

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through text readings and self-directed research you will conduct using the published literature and on the web and through hands-on experimentation with various tools and technologies.

You will finish the course by completing a GIS programming project on a topic of your choice on your own.

**Technological and Communication Requirements**

ArcGIS is provided online via the SSI Server; hence, you do not need to install it on your own computer. Instead, every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone for use whenever a presentation or meeting is scheduled.
- An up-to-date web browser to access the SSI Server

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

**Communications** – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard. It is each student’s responsibility to stay informed about what is going on in our course. In addition to email about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. Be sure to check these each time you log onto Blackboard.
I will send via email through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all email sent from Blackboard or from me. Do not ignore course email until the day before assignments are due. Also double check to be sure that email sent from the USC blackboard account does not go into your junk mail!

While I am usually on-line all day and will probably respond to emails from students very quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72 hours delay. In the rare case when I expect to be off-line for more than 72 hours, I will post an announcement on the Blackboard site.

Discussion forums – On the Blackboard site, I will post a series of discussion threads relevant to various sections of the course. Discussions provide a key means for student-to-student discussion and collaboration that can replicate the face-to-face contact you may have experienced in traditional classrooms. Here students can provide support to each other while working on the assignments, sharing hints and helpful tips, as you would in a classroom laboratory. Please post your questions about assignments there, as you would ask them publically in the classroom. I monitor the discussion threads and will offer comments when appropriate, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Required Readings and Supplementary Materials

The required textbooks for this course are:


The aforementioned textbooks will be supplemented with Course Notes and a mixture of readings from academic journals, professional reports and authoritative websites. Additional readings relevant to students' interests as well as course themes will be identified as part of the literature search components.

Readings – To be posted to Blackboard under Course Documents:


**Description and Assessment of Assignments**

**Weekly Assignments**

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

**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.

**Reading Assignments – 6 worth a total of 12 points.** These will focus on the theory portion of the course as presented in the weekly readings. Their objective is to help you evaluate and integrate the information you have acquired from the course readings. Some of these will involve discussions and collaborative work and some will be individual efforts.

**Discussions – 6 worth a total of 6 points.** Structured discussions will focus on combinations of theory and practice. You will post new messages and replies to messages posted by your classmates (i.e. two per forum) at specified times throughout the class.

**Programming Assignments – 10 worth a total of 40 points.** In order to demonstrate that you understand the basic concepts and skills learned in the class, you will complete 10 Programming assignments that involve the use of Python and/or ArcGIS. Once you have completed each assignment, you will turn in a word document with maps, workflows, illustrations, and code itself, or an installation package to show your work. Usually, there are several questions for each assignment. Each question corresponds to a different step during the hands-on assignment process, and has a corresponding point attached to it.
Final Project

To integrate your learning of the material covered in the course, you will design, undertake, and report on an individually chosen Python programming or Esri Modelbuilder project. The four components of the Final Project are:

Proposal - 4 points. Two meetings (live via BlueJeans) and a brief written description of the GIS programming and customization application(s) you would like to build and how you plan to do it.

Presentation - 10 points. A presentation on the individual final project made online via BlueJeans, open to all students in the course.

Final Report - 16 points. A written report (double-spaced, 12-point font) of no more than 12 pages in length (not counting figures, tables and references) on your project methodology and outcomes.

Poster - 10 points. An academic poster of your final report that shows the introduction, background, methods, results, conclusions, limitations, and references. You are encouraged to display your project poster at the Esri User Conference or the Annual Meeting of the Association of American Geographers. You will share the electronic version of it with the whole class on Bb, and make some comments for your classmates’ posters.

Grading Breakdown

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Number</th>
<th>Points Each</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Assignments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resume Assignment</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Reading Assignments</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Discussions</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Programming Assignments</td>
<td>10</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Project Components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposal</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Presentation</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Poster</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Final Report</td>
<td>1</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

Total | 27 | - | 100

Assignment Submission Policy

Assignments will be submitted for grading via Blackboard using the due dates specified in the Course Schedule below. And finally, it is important to note from the outset that: (1) late postings and assignments will be docked one letter grade and no grade will be given for postings or assignments turned in more than seven days late; and (2) no written work other
than the final project posters and project post discussion will be accepted for grading after 5:00 p.m. PT on Friday, 28 April.

**Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings</th>
<th>Deliverables/Due Dates</th>
</tr>
</thead>
</table>
| **Week 1**<br>1/9 | **Introduction:** Introduction to the theory of spatial representation and modeling | Longley (2004)  
Doan (2000) | Resume Assignment:  
Friday, 1/13 |
| **Week 2**<br>1/17*<br>*Monday, 1/16 is a university holiday | **Practical Modeling:** Introduction to Esri Modelbuilder | Batty & Xie (2005)  
Allen (2011) Ch.1 | Reading Assignment 1:  
Friday, 1/20  
Discussion Forum 1:  
Friday, 1/20 |
| **Week 3**<br>1/23 | **Applied Modeling In GIS:** Building interactive models using Esri Modelbuilder | Allen (2011) Ch.2  
Shaw (2013) Sec.1-6 (Optional) | Reading Assignment 2:  
Friday, 1/27  
Discussion Forum 2:  
Friday, 1/27  
Programming Assignment 1:  
Friday, 1/27 |
| **Week 4**<br>1/30 | **Programming Basics – Part 1:** Fundamental Python concepts & flow control in Esri Modelbuilder | Allen (2011) Ch.3  
Esri Web Campus: 1. Python for Everyone | Programming Assignment 2:  
Friday, 2/3  
optional Lpy:  
Friday, 2/3 |
| **Week 5**<br>2/6 | **Programming Basics – Part 2:** Introduction to ArcMap Python window & Python language fundamentals | Allen (2011) Ch.4&5  
Zandbergern (2013) Ch.3&4  
Shaw (2013) Sec.27-38 (Optional) | Programming Assignment 3:  
Friday, 2/10  
optional Lpy:  
Friday, 2/10 |
| **Week 6**<br>2/13 | **Object-Oriented Programming & Workflows:** Utilizing model iterations & geoprocessing using Python in ArcMap | Glennon (2010)  
Bian (2007)  
Allen (2011) Ch.6  
Zandbergern (2013) Ch.5  
Esri Blog: GIS Workflow Automation | Programming Assignment 4:  
Friday, 2/17  
optional Lpy:  
Friday, 2/17  
Project Proposal Meeting:  
TBD |
<table>
<thead>
<tr>
<th>Week 7 2/21*</th>
<th><strong>Computing with Data – Part 1:</strong> Building model documentation &amp; manipulating of spatial data in models</th>
<th>Allen (2011) Ch.7 Zandbergen (2013) Ch.6.7&amp;8</th>
<th><strong>Reading Assignment 3:</strong> Friday, 2/24 Discussion Forum 3: Friday, 2/24 Programming Assignment 5: Friday, 2/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Monday, 2/20 is a university holiday</td>
<td><strong>Computing with Data – Part 2:</strong> Creating &amp; sharing geoprocessing packages</td>
<td>Esri Web Campus: 2. Sharing Workflows Using Geoprocessing Packages Zandbergen (2013) Ch.9</td>
<td><strong>Programming Assignment 6:</strong> Friday, 3/3</td>
</tr>
<tr>
<td>Week 10 3/20</td>
<td><strong>GIS Automation and Customization – Extensions:</strong> Building &amp; sharing ArcMap extensions</td>
<td>Esri Guide Book: Using Extensions in ArcGIS</td>
<td><strong>Reading Assignment 4:</strong> Friday, 3/31 Programming Assignment 9: Friday, 3/31</td>
</tr>
<tr>
<td>Week 11 3/27</td>
<td><strong>Consuming and Distributing Code:</strong> Exploring Esri GitHub &amp; Esri Development Summit Proceedings</td>
<td>ESRI Blogs and Articles</td>
<td><strong>Discussion Forum 4:</strong> Friday, 4/7 Programming Assignment 10: Friday, 4/7</td>
</tr>
<tr>
<td>Week 12 4/3</td>
<td><strong>Principles and Practices of Software Development:</strong> Exploring Esri ArcPy Cafe &amp; GeoNet</td>
<td>Carver &amp; Epperly (2014)</td>
<td><strong>Reading Assignment 5:</strong> Friday, 4/14 Discussion Forum 5: Friday, 4/14 Project Progress Meeting: TBD</td>
</tr>
<tr>
<td>Week 13 4/10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 Section 11, Behavior Violating University Standards https://policy.usc.edu/student/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.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu or to the Department of Public Safety http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Relationship and Sexual Violence Prevention Services http://engemannshc.usc.edu/rsvp/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali.
which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs*

[http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* [http://emergency.usc.edu](http://emergency.usc.edu) will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

**Resources for Online Students**

The Course Blackboard page and the SSI 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/](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](https://libraries.usc.edu/faculty-students/distance-learners). This includes instructional videos, remote access to university resources, and other key contact information for distance students.