SSCI 586 – GIS Programming and Customization (Section 35759) Course Syllabus – Fall 2014

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I am always available asynchronously via email. I am also available for synchronous chats via phone or Skype, audio or video most days and times *by prior arrangement* via email. Or we can meet in my Adobe Connect room. Just get in touch!

Course Scope and Purpose

This course is designed to provide students with the most up-to-date tools and information necessary for building and implementing customized GIS mapping applications and geoprocessing functions according to current industry standards. The tools and concepts we will cover comprise an introduction to programming languages and development practices commonly used to integrate, customize, automate and extend desktop GIS technologies to meet the specific needs of end users. We begin with an overview of GIS modeling and its translation into GIS software development and object-oriented programming. We next cover the Python programming language, followed by its use in developing customized GIS applications directly applicable to the student's field of interest. This course will provide a solid foundation for programmatically interacting with Esri's ArcGIS ecosystem.

We will cover several topics:

Software Development and Object-Oriented Programming – We start with a basic review of modeling concepts in the context of environmental systems, and then programming, which is more than just writing code. In fact writing the code is the easy part – making sure it runs appropriately is the challenging part. We will also address issues of quality in the context of software development because creating special programs within or for GIS applications must be performed quickly, efficiently and accurately. Object-oriented programming (OOP) and the effective use of appropriate software development strategies are two ways to achieve these goals.

Programming Languages for GIS Development – We also introduce Python, an accessible open source and proprietary programming language. The goal is for students to be able to critically evaluate such languages for application development and gain enough proficiency to be able to develop GIS customizations to suit their own needs.

Customized GIS Application Development – In this most hands-on part of the course, we will start by analyzing and developing GIS models by means of key modeling elements focusing on their sequential connection and interaction as examples of GIS customization. We will next undertake the creation of simple GIS applications with and without desktop GIS interaction. We will cover methods by which students can add value within existing GIS software through custom tool development as well as how to extend the set of available tools by building and deploying user-specific extensions.

Learning Outcomes

When you have completed this course, you will be able to:

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

Course Formats

This a graduate level course, so you should expect this class to be both academically robust and 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 fellow classmates. The challenge for us is to replicate such an academic experience within the milieu of "distance learning".

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through course notes and assigned readings. Hands-on practical assignments will use various software products accessible over the Internet. Assignments will give students an opportunity to internalize and apply the concepts and theory learned from readings. Some assignments require student interaction, all will benefit from it.

We have several technologies that will facilitate our course work and our interactions, despite our dispersed locations. These include:

Blackboard – All course materials and correspondence will be posted on the course Blackboard site. As a registered student you will find this course will show up in your available courses at 12:00 noon PT on the first day of classes. It is here that the day-to-day flow of the course will be recorded.

Discussion Boards – We will post a number of discussion threads relevant to various sections of the course on the Blackboard site. I may or may not participate in all of these threads but they are vitally important when we get to the hands-on work as we expect students to work "together" on these assignments, sharing hints and help as you would do in a common laboratory classroom. Additional discussion threads will be used to organize asynchronous discussions.

Live meetings and presentations – We use a browser-based service called Adobe Connect to create synchronous interaction sessions. With voice and webcam capabilities Adobe Connect can be used to share presentations and even our desktops between two or more people.

Individual meetings – While Adobe Connect can be used for one-on-one meetings, we generally find it is easier to use the free VOIP and chat technology, Skype (http://www.skype.com) for individual chats.

GIST server and tech support – This course will utilize the GIST Server. If you experience any type of technical issues, send an email to GIST Tech Support at gistsupport@dornsife.usc.edu and make sure to copy (cc) me on the email. GIST Tech Support is available Monday through Friday, 9:00 a.m.-5:00 p.m. PT

Assessment

Your grade in this class will be determined on the basis of several different assessment tools. Each week, by Monday, we will post a Weekly assignment outlining the work you are expected to complete that week with the relevant due dates. Assignments will be due on the Friday following the week in which they are assigned.

Resume Assignment – 1 for a total of 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared GIST Student Community Blackboard site. With your permission, your photo and resume will be posted to the Spatial Sciences Institute website and your resume will be included in the GIST Resume Book. The latter is compiled annually and along with our web presence used to promote our programs and more importantly, your skills, experience, and professional aspirations.

Reading Assignments – 5 for a total of 10 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.

Modeling/Programming Assignments/Tutorials – 12 for a total of 48 points. Most weeks you are expected to work through one or more Assignments that involve the use of Python and/or ArcGIS. To demonstrate that you have completed each assignment, you will turn in a quick copy of some digital output from the final part of the assignment such as a .jpg at the final step, and/or some combination of a few brief text answers, the code itself or an installation package resulting from your code.

Final Project – 2 components for a total of 40 points. The Final Project is your opportunity to integrate all that you have learned in the semester. It consists of a proposal, a final report and presentation. In the Final Projects you will:

1. Frame a spatial question or application scenario that can be solved using a customized GIS application, automation, customization or extension.

2. Collect appropriate spatial and non-spatial data to be used as input.
3. Determine the technologies to be used (i.e. language(s), GIS functionalities) to implement the approach.
4. Establish the important intermediate steps in programming and implementation, including testing/debugging.
5. Produce a working application implementing your approach that you will demonstrate (live via Adobe Connect) during your final presentation and submit as an installable application.

The Final Project will have four components:

1. Proposal (10 points) – a Presentation (live via Adobe Connect) of the problem or scenario you are attempting to address including the data and technologies chosen for the project, your proposed method for implementing a solution, your expected outcomes and deliverables, and any potential problems that you think could arise.
2. Program Implementation (10 points), Final Project (20 points) and Presentation (10 points) – the final three components are linked and consist of an installable version of your project implementation along with a report describing your experience including the problem or application scenario you chose to address, a detailed description of how it was implemented and issues encountered while completing the project and how you overcame them, and a presentation. The project implementation must be installable and work as described in the report. The presentation (live via Adobe Connect) will consist of 3-5 slides illustrating highlights from the report followed by a live demonstration of your application. Presentations will be scheduled in groups.

Careful planning and a serious, consistent commitment will be required for you to successfully navigate the various deliverables in this and other GIST courses. The table below summarizes the SSCI 586 course assignments and their point distribution:

Assignments	Number	Points Per Assignment	Total Points
Exercises	12	4	48
Reading Assignments	5	2	10
Resume Assignment	1	2	2
Final Project:			
Proposal	1	10	10
Final Report/Application	1	20	20
Final Presentation	1	10	10
Totals	**21**	**-**	**100**

Grades in this and other GIST courses will use the standard USC grading criteria, as follows:

A	≥ 93 points	B-	80-82 points	D+	67-69 points
A-	90-92 points	C+	77-79 points	D	63-66 points
B+	87-89 points	C	73-76 points	D-	60-62 points
B	83-86 points	C-	70-72 points	F	< 60 points

And finally, it is important to note from the outset that: (1) late postings and assignments will be docked one grade and no grade will be given for postings or assignments turned in more than one week late; and (2) no written work will be accepted for grading after 5:00 p.m. PT on the last day of classes.

Requirements

Textbooks – The following two books are required for this course. Both books are available from the USC Bookstore or online outlets such as Amazon.com. Be sure to order your textbook to arrive by the fastest method possible as you will need them immediately.

- Allen, David, 2011. Getting to Know ArcGIS ModelBuilder. Redlands, Esri Press., 336 p. http://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=195&moduleID=0. We will refer to this as **GTM** in the Course Notes, Tutorials etc.
- Zandbergern, Paul A., 2013. Python Scripting for ArcGIS. Redlands, Esri Press., 368 p. http://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=224&moduleID=0. We will refer to this as **PSA** in the Course Notes, Tutorials etc.

Readings – To be posted to Blackboard under Course Documents:

- Longley, P.A. (2004). Geographical Information Systems: on Modeling and Representation. *Progress in Human Geography*, 28, 108-116.
- Batty M. and Xie Y. (2005). Urban Growth Using Cellular Automata Models. In Maguire, D.J., Batty, M. and Goodchild, M.F. (eds.), *GIS, Spatial Analysis, and Modeling,* Redlands, CA, ESRI Press, 151-172.
- Bian, L. (2007). Object-Oriented Representation of Environmental Phenomena: Is Everything Best Represented as an Object? *Annals of the Association of American Geographers*, 97(2), 267-281.
- Zou, L., Miller, S.N., Schmidtmann, E.T. (2007). A GIS Tool to Estimate West Nile Virus Risk Based on a Degree-Day Model. *Environmental Monitoring and Assessment*, 129: 413-420.
- Glennon, A. (2010). Creating and Validating Object-Oriented Geographic Data Models: Modeling Flow within GIS. *Transactions in GIS*, 14(1), 23-42.
- Goodchild, M.F. (2010). Spatial Analysis and Modeling. In Bossler, J.D., Campbell, J.B., McMaster, R.B., Rizos, C. (eds.), *Manual of Geospatial Science and Technology*, Second Ed. CRC Press (November 22, 2001), 575-591.

Technology – There are several technology requirements:

- An up-to-date computer with a fast Internet connection, such as DSL or equivalent.
- A functional webcam together with a microphone or headset for meetings.
- Python 2.7.3 or greater (installs automatically with ArcGIS 10.2):
- http://www.python.org/download/. ArcGIS is provided on-line via the GIST Server, you do not need to install it on your own computer.

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 the Blackboard Assessment link. I will also create Blackboard discussion forums throughout the semester that we will use for the aforementioned assignments and so we can discuss issues and comments on the course assignments, exercises, and projects as the need arises.

In addition, 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. Check now to make sure that mail sent from both the USC blackboard accounts and my private domain (jswift@usc.edu) does not go into your junk mail.

While I am usually online and will probably respond to emails from students relatively quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 48 hours delay. In the rare case when I expect to be offline for more than 72 hours, I will post an announcement on the Blackboard site.

That said, 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.

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.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to an instructor as early in the semester as possible. DSP is located in STU 301 and is open from 8:30 a.m. to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles.

Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A (see http://scampus.usc.edu/wp-content/uploads/2011/07/university_governance.pdf for additional details). Students will be referred to the Office of Student Judicial Affairs and

Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at http://www.usc.edu/student-affairs/SJACS/.

Important Administrative Dates

8/25: Fall semester classes begin
9/1: Labor Day, university holiday
9/12: Last day to register and add classes
9/12: Last day to change enrollment option to Pass/No Pass or Audit
9/12: Last day to drop a class without a mark of "W" and receive a 100% refund
11/14: Last day to drop a class with a mark of W
11/26-29: Thanksgiving recess, university holiday
12/5: Fall semester classes end
12/6-9: Study days
12/17: Final Examinations end
12/18-1/11: Winter Recess

*http://classes.usc.edu/term-20143/calendar/

* Monday September 1 is a university holiday
**Dec. 5 End of semester

Tentative Schedule (35759)

Week #	Week Begins	Theme	Week's Readings and Practice	Assessments due Monday following		
			Reading	Reading Assign.	Hand-On Assign.	Meetings and Reports
1	8/25	Introduction & Modeling Theory	Notes, papers	1		Resume
2	9/2*	Practical Modeling	Notes, GIST intro, GTM1		1	
3	9/8	Applied Modeling In GIS	Notes, paper, GTM2	2	2	
4	9/8	Programming Basics	Notes, GTM3		3	
5	9/22	Object-Oriented Programming	Notes, GTM4-5, PSA3-4		4	
6	9/29	Continued…	Notes, GTM6, PSA6-7-8		5	Individual Meetings
7	10/6	Computing with Data	GTM, PSA		6	Proposal
8	10/13	Continued…	Notes, Share-Ge0Processing Packages, PSA9	3	7	
9	10/20	Programming for GIS	Notes, Tools, Customization		8	
10	10/27	GIS Automation and Customization – Add-Ins	Notes, Share Add-Ins	4	9	
11	11/3	GIS Automation and Customization – Extensions	Notes, Extension		10	
12	11/10	Consuming and Distributing Code	Notes, Open Source		11	Individual Progress Meetings
13	11/17	Continued….	Notes, Paper	5	12	
14	11/24	Thanksgiving break (11/26-29)				
15	12/1	Principles and Practices of Software Development	Notes, Paper			
**	12/5	Future of GIS Programming	Notes			Final Application, Presentation and Project Report