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

SSCI 580 (35890), Spatial Computing

Syllabus

Units: 4

Term — Day — Time: Fall 2016; Wed and Fri; 12:00 - 1:50 pm PT

Location: AHF 145D

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

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

Library 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

This class will cover the concepts, theory, methods, techniques, and programming for spatial computing. This includes the latest research in a variety of topics that are central to spatial computing, including Geospatial Mashups, Cyber GIS and Cloud GIS, Spatial Data Mining, Essential Python Geospatial Libraries, Volunteered Geographic Information (VGI) and Big Data, Geocoding, and Geospatial Semantic Web. Students will also gain a deep understanding and hands-on software experience, including ArcGIS Desktop, Google Map and Google Earth, SPARQL, and Cyber GIS applications. Students will learn how to collect, transform, analyze, and visualize your own spatial datasets while avoiding common pitfalls and building better location-aware technologies.

This is a required class for the Spatial Informatics M.S. Program.

Learning Outcomes

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

- Discuss the relevant Web-based Geographic Information Systems and techniques for working with geospatial data;
- Empower high-performance and scalable CyberGIS by exploiting spatial characteristics of data and analytical operations for achieving unprecedented capabilities for geospatial scientific discoveries;
- Build and use cloud services that combine geographic data, application, software, or platform as open source solutions for spatial issues.
- Apply relevant Spatial Data Mining techniques to solve a variety of spatial problems;
- Select and use external Python Geospatial libraries to solve real-world problems with greater flexibility;
- Discuss the technology trend of Volunteered Geographic Information and how it relates to Big Geospatial Data and GIS design;
- Recognize methods to geocode text data with a spatial context;
- Discuss how Semantic Web technology fits into the present and future evolution of GIS, and how it differs from existing data-sharing technologies, such as relational databases and the current state of the World Wide Web.

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

Course Structure

This residential course will unfold on a weekly basis. Each week will be focused on a particular aspect of Spatial Computing, delivered through lectures, reading assignments,

class participation, and hands-on computer lab assignments. In addition to the assigned readings, students will receive an extensive list of Supplementary Readings. Students are encouraged to bring questions and problems to class to be explored in that congenial setting. The aim is to encourage deep-learning by active participation. In this class the labs are designed to give students first-hand experience with the wide variety of software and programming packages that can be used for spatial computing. At the end of this semester, students will complete a final project including a 20-minute presentation, a poster and a report (double-spaced, 12-point font) no more than 8 pages in length.

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 your 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 offer comments when necessary, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Reference List

* In addition to the assigned readings, students will receive an extensive list of Supplementary Readings.

1. Google. (2013). Google Earth Outreach. Retrieved from https://www.google.com/earth/outreach/tutorials/.
2. Evans, Michael R., Dev Oliver, KwangSoo Yang, Xun Zhou, & Shashi Shekhar. (2014). Enabling spatial big data via CyberGIS: challenges and opportunities. In S.Wang and M.Goodchild (eds.), *CyberGIS: Fostering a New Wave of Geospatial Innovation and Discovery.* Berlin, Germany: Springer.
3. Armstrong, Marc P., Timothy L. Nyerges, Shaowen Wang, & Dawn Wright. (2011). Connecting geospatial information to society through cyberinfrastructure (pp. 109-122). *The SAGE Handbook of GIS and Society.* London, UK: Sage Publications.
4. Wang, Shaowen. (2010). A CyberGIS framework for the synthesis of cyberinfrastructure, GIS, and spatial analysis. *Annals of the Association of American Geographers,* 100(3): 535-557.
5. Yang, Chaowei, Robert Raskin, Michael Goodchild, & Mark Gahegan. (2010). Geospatial cyberinfrastructure: past, present and future. *Computers, Environment and Urban Systems,* 34(4): 264-277.
6. Yang, Chaowei, Michael Goodchild, Qunying Huang, Doug Nebert, Robert Raskin, Yan Xu, Myra Bambacus, & Daniel Fay. (2011). Spatial cloud computing: how can the geospatial sciences use and help shape cloud computing? *International Journal of Digital Earth,* 4(4): 305-329.
7. Zhang, Qi, Lu Cheng, & Raouf Boutaba. (2010). Cloud computing: state-of-the-art and research challenges. *Journal of internet services and applications,* 1(1): 7-18.
8. Shekhar, Shashi, & Sanjay Chawla. (2003). *Spatial databases: a tour*. Upper Saddle River, NJ: prentice hall.
9. GeoPandas Developers. (2016). GeoPandas Online Tutorial. Retrieved from http://geopandas.org/index.html.
10. PySAL Developers. (2014). PySAL Online Tutorial. Retrieved from http://pysal.readthedocs.io/en/latest/users/tutorials/intro.html.
11. Sui, Daniel, & Michael Goodchild. (2011). The convergence of GIS and social media: challenges for GIScience. *International Journal of Geographical Information Science,* 25(11): 1737-1748.
12. Goldberg, Daniel W., & Myles G. Cockburn. (2010). Improving geocode accuracy with candidate selection criteria. *Transactions in GIS,* 14(S1): 149-176.

13. Janowicz, Krzysztof, Simon Scheider, Todd Pehle, & Glen Hart. (2012). Geospatial semantics and linked spatiotemporal data: past, present, and future. *Semantic Web,* 3(4): 321-332.

14. Kuhn, Werner. (2005). Geospatial semantics: why, of what, and how? Journal on Data Semantics III (pp. 1-24). Berlin, Germany, Springer-Verlag Lecture Notes in Computer Science Vol. 3534.

Description and Assessment of Assignments

Weekly Assignments

Your grade in this class will be determined on the basis of several different assessment tools. These are described in the Weekly Folders on Blackboard. Due dates are shown in the summary that follows.

Resume Assignment – 1 worth 1 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.

Lab Assignment – 5 worth 15 points. Students will be assigned 5 labs during the entire.

Review Report – 13 worth a total of 26 points. Students will write a report (single-spaced, 12-point font) no more than 1 pages in length. These will focus on the text and other assigned readings. One will be due every week. 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, most will be individual efforts.

Class Participation – 13 worth a total of 26 points. There will be weekly discussion on the lectures and reading assignments.

Final Project

To integrate your learning of all the material covered in the course, in the final project you will design, undertake and report on an individually chosen spatial computing project that will be the context of discussion in class. The four project components will be due at different times during the term to build gradually on the material presented in the course. All points for project components will be assigned using a grading rubric provided at the time the project assignment is posted. The four components of the Project are:

Proposal - 2 points. A brief description of the spatial question(s) you would like to ask or the spatial problem you want to solve and briefly how you plan to solve it.

Poster - 10 points. A poster of your final report that shows the introduction, background, methods, results, discussion and limitation, reference etc. You will share the electric

version of it with the whole class on Bb, and make some comments for your classmates' poster.

Presentation - 10 points. A presentation made in class, open to all students.

Project Report - 10 points. A written report (double-spaced, 12-point font) no more than 8 pages in length on your project methodology and outcomes.

Grading Breakdown

Assignment	Number	Points Each	Total Points
Weekly Assignments			
Resume Assignment	1	1	1
Review Report	13	2	26
Class Participation	13	2	26
Lab Assignment	5	3	15
Project Components			
Proposal	1	2	2
Poster	1	10	10
Presentation	1	10	10
Final Report	1	10	10
Totals	36	-	100 points

Assignment Submission Policy

Assignments will be submitted for grading via Blackboard using the due dates specified in the Course Schedule below.

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. Students can turn in a lab assignment up to seven days late with a 20% penalty.

Schedule

*We made some changes for the final week based on the new university policy.

	Topic	Readings and Assignments	Deliverables/Due Dates
Week 1 8/22	Online GIS and Geospatial Mashups	SSCI 580 Syllabus Google (2013) Review Report #1 Lab Assignment #1	Resume Assignment: Wed. 8/24 Review Report #1: Wed. 8/24
Week 2 8/29	Cyberinfrastructure and CyberGIS (I)	Evans (2013) Armstrong (2011) Review Report #2 Lab Assignment #2	Lab Assignment #1: Wed. 08/31 Review Report 2: Wed. 08/31
Week 3 9/6*	Cyberinfrastructure and Cyber GIS (II)	Wang (2010) Yang (2010) Review Report #3	Review Report #3: Wed. 9/14

*Monday, Sept.5 is a university holiday			
Week 4 9/12	Spatial Cloud Computing (I)	Yang (2011) Review Report #4	Review Report #4: Wed. 9/14 Lab Assignment #2: Wed. 9/14
W**eek 5** 9/19	Spatial Cloud Computing (II)	Zhang (2011) Review Report #5	Review Report #5: Wed. 9/21
Week 6 9/26	Spatial Data Mining (I)	Shekhar Ch. 7 (2002) Review Report #6 Lab Assignment #3	Review Report #6: Wed. 9/28
Week 7 10/3	Spatial Data Mining	Shekhar Ch. 7 (2002) Review Report #7	Review Report #7: Wed. 10/5
Week 8 10/10	Introduction to Essential Python Geospatial Libraries (I)	GeoPandas Developers (2016) Review Report #8 Lab Assignment #4	Review Report #8: Wed. 10/12 Lab Assignment #3: Wed. 10/12
Week 9 10/17	Introduction to Essential Python Geospatial Libraries (II)	PySAL Developers (2016) Review Report #9	Review Report #9: Wed. 10/19 Lab Assignment #4: Wed. 10/20
Week 10 10/24	Volunteered Geographic Information and Big Data	Sui (2011) Review Report #10 Lab Assignment #5	Review Report #10: Wed. 10/26
Week 11 10/31	Geocoding and Linking Text to Location	Goldberg (2010) Review Report #11	Review Report #11: Wed. 11/2
Week 12 11/7	Geospatial Semantic Web and Spatial Data Reasoning (I)	Janowicz (2012) Review Report #12	Review Report #12: Wed. 11/9
Week 13 11/14	Geospatial Semantic Web and Spatial Data Reasoning (II)	Kuhn (2005) Review Report #13	Review Report #13: Wed. 11/16 Lab Assignment #5: Wed. 11/16
Week 14 11/21* *Thursday, 11/24 and Friday 11/25 are university holidays	Future of Spatial Computing		

Week 15 11/28	Final Project	Q & A session	
Final Exam 12/7* *Dec. 3-6 are Study Days	Final Project and Presentation	Final Project and Presentation	Final project presentation on Friday Dec. 9, 11:00 am PT Submit the final project PPT before the day you present Submit the final project poster no later than Friday 12/9 at 5:00 p.m. PT and comments to your classmates' posters on the no later than 5:00 p.m. PT on Sunday, 12/11

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 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 will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.