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

# SSCI 591 (35729), Web GIS

**Units**: 4
**Term**: Fall 2015
**Location**: Online, via Blackboard

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## Course Description

Today, acquiring programming concepts and skills underlying construction and implementation of high quality Web GIS applications is a critical asset to both academic and professional portfolios. Learning to program innovative web-based mapping applications facilitates sharing and dissemination of your work, and at the same time vastly expands your overall application development skillset. Familiarity with web scripting languages and how these are utilized to implement Web GIS applications provides in-depth insight into how many government and commercial organizations as well as individuals develop these tools. The main goal of this course is to help you become comfortable with coding web-based applications that appeal to a broad or specialized audience and that can be readily shared with a crowd.

*Why should you take this course?* This course will provide you with the most up-to-date software tools and information necessary for developing customized Web GIS applications according to current industry standards. It is assumed that students taking this course are new to web scripting and application development, and have no prior programming experience. Essential practical as well as theoretical concepts of Web GIS are covered. You will learn to develop Web GIS applications through popular open source and proprietary GIS and related development tools such as Google Maps, Esri ArcGIS Server, ArcGIS.com and other cloud-based technologies and using Application Programming Interfaces (APIs). You will also learn the fundamentals of Web GIS system architecture as well as advanced programming topics including web mashups and distributed geospatial web services. Experience using Web 2.0 technologies that focus on user generated content, geoportals for finding and accessing geospatial information, and web mapping interoperability in terms of utilizing open source universal data standards is also provided. In addition, the current state of e-business and e-government web mapping interests are covered.

This is 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 fellow classmates. The challenge for the instructor is to replicate such an academic experience within the milieu of "online learning."

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

## Learning Objectives

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

- Familiarize yourself with different web scripting languages commonly used in Web GIS application development, and how to use these technologies to extend exiting GIS software functionality.
- Critically evaluate the benefits and challenges of developing Web GIS applications using different software technologies and system architectures, including local infrastructure versus cloud-based computing.
- Explain how Web GIS technologies are applicable to academia, e-business and e-government.
- Develop and implement your own Web GIS projects, geospatial web services, mashups, Volunteered Geographic Information (VGI) and Public Participation GIS (PPGIS) applications.
- Conceptualize, design, implement and write up the results of a unique Web GIS application based on your own interests and goals in the course final project.

**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 Web GIS. In order to encourage collaboration, for some assignments the class will be divided into small groups to work on programming assignments. Group members will share and test each other's work in brief Discussion threads (online). You will finish the course by completing a Web GIS project on a topic of your choice on your own.

## Technological Proficiency and Hardware/Software Requirements

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 classes no later than 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 – On the Blackboard site, we will post a number of discussion threads related to various course topics. These threads are very important in terms of providing support to each other while working on class exercises to share hints and helpful tips, as you would do in a classroom setting, as in a GIS lab setting. I will check the discussion threads periodically and offer occasional comments. Please send your course instructor an email directly if you have a question or concern that requires immediate attention.

Live meetings and presentations – We will use a browser-based service called Adobe Connect™ to create synchronous, interactive 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 – Adobe Connect can be used for one-on-one meetings, as well as BlueJeans™ for individual chats.

GIST VM and tech support – This course will utilize an individual SSI GIST Virtual Machine (VM), or virtual server, for each student enrolled in the course. If you are unable to connect to your personal VM or experience any type of technical issues, send an email using your USC account to GIST Tech Support at gistsupport@dornsife.usc.edu, making sure to copy (cc) me on the email. GIST Tech Support is available Monday through Friday, from 9 a.m. to 5 p.m. PT.

ArcGIS and ArcGIS Server are provided online via each GIST VM; hence, you do not need to install them on your own computer. Every student must have the following technology requirements:

- An up-to-date computer with a fast Internet connection.
- A functional Web camera and a microphone or headset for live sessions.
- A modern Web browser (Firefox or Opera recommended) to run ArcGIS which is provided online via the GIST Server; you do not need to install ArcGIS on your own computer.

## Required Readings and Supplementary Materials

Textbooks – There are two required textbooks for this course. These can be purchased from the USC bookstore or online outlets such as Amazon.

- Fu, Pinde, and Jiulin Sun. 2011. *Web GIS: Principles and Applications*. Redlands, Esri Press., 296 pp. ISBN 9781589482456
- Petroutsos, Evangelos. 2014. *Google Maps: Power Tools for Maximizing the API*. New York, NY, McGraw-Hill Osborne Media, 464 pp. ISBN 9780071823029

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

Readings – To be posted to Blackboard under Course Documents:

- Berners-Lee, Tim. 1996. "The World Wide Web: Past, Present and Future." Cambridge, MA, Massachusetts Institute of Technology, Laboratory for Computer Science. Accessed July 8, 2015. http://www.w3.org/People/Berners-Lee/1996/ppf.html.
- Jones, Christopher B., and Ross S. Purves. 2008. "Web-based GIS." In *The Handbook of Geographical Information Science,* edited by John P. Wilson and A. Stewart Fotheringham, 559-580. Oxford, Wiley-Blackwell.
- Peng, Zhong-Ren, and Ming-Hsiang Tsou. 2003. "Quality of service and security issues in distributed GIS." In *Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Network,* 500-533. New York, John Wiley & Sons, Inc.
- Zhao, Peisheng, Theodore Forester, and Peng Yue. 2012. "The geoprocessing web." *Computers & Geosciences* 47:3-12.
- Elwood, Sarah, Michael F. Goodchild, and Daniel Z. Sui. 2012. "Researching volunteered geographic information: spatial data, geographic research, and new social practice." *Annals of the Association of American Geographers* 102 (3): 571-590.
- Lin, Wen. 2013. "When Web 2.0 meets public participation GIS (PPGIS): VGI and spaces of participatory mapping in China." In *Crowdsourcing Geographic Knowledge: Volunteered Geographic Information (VGI) in Theory and Practice,* edited by Sui, Daniel Z., Sarah Elwood and Michael F. Goodchild, 83-103. New York, Springer.
- Goodchild, Michael F. 2008. "Spatial accuracy 2.0." In *Proceedings of the Eighth International Symposium on Spatial Data Accuracy Assessment in Natural Resources and Environmental Sciences (ACCURACY'08)*, edited by Michael F. Goodchild and Jingxiong Zhang, 1-7. Shanghai, China.
- Holman, Justin. 2012. "Spatial Career Guide: 5 Key for Future GIS Software Developers*."* Geographical perspectives. Pueblo, CO: Colorado State University, Hasan School of Business. Accessed July 8, 2015. http://www.justinholman.com/2012/03/29/spatial-career-guide-5-key-skills-for-future-gis-software-developers/.
- Wang, Shaowen, Luc Anselinf, Budhendra Bhadurig, Christopher Crosbyh, Michael F. Goodchildi, Yan Liua and Timothy L. Nyergesj. 2013. "CyberGIS software: a synthetic review and integration roadmap." *International Journal of Geographical Information Science* 27(11): 2122:2145.

## Description and Assessment of Assignments

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

Resume Assignment (2%) – 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. Unless you opt out, your photo and short biographical sketch may 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 (10%) – 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.

Discussion Forums (8%) – These will focus on varying combinations of theory and practice and anticipate that you will contribute to and participate in a series of discussion threads at designated times throughout the semester.

Programming Assignments (35%) – In order to demonstrate that you understand the basic concepts and skills learned in the class, you will complete seven assignments that involve the use of web scripting languages and Web GIS software. Once 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 script itself or hyperlinks to your working web pages and web-based mapping applications resulting from your code.

Final Project (45%) – To integrate your learning of all the material covered in the course, you will design, undertake and report on an individually chosen Web GIS project that will be the context of discussion in several of the assignments. The six components of the Final Project are:

- *Proposal - 4 points*. One meeting (live via Adobe Connect) and a brief written description of the Web GIS application you would like to build and how you plan to do it.
- *Technology & Data Report - 5 points.* A written report describing the software tools you have chosen to implement and the spatial and non-spatial data you intend to utilize in your project.
- *Presentation - 5 points.* A presentation and live demonstration of your Web GIS application made online via Adobe Connect, open to all students in the course.
- *Application Implementation - 15 points.* The Web GIS application will consist of a unique, live website with an interactive web map, including any data required in your application. The application must work as described in your Final Project Report.
- *Final Project Report - 10 points.* A written report on your project methodology, data and application development outcomes, including how to install and run your application.

- *Video – 6 points.* You will create a demo video that describes and demonstrates the full functionality of your Web GIS application project. The first will cover your presentation, and the second will be a live demonstration of your application.

## Grading Breakdown

The table below summarizes the SSCI 591 course assessments and their point distribution:

| **Assessment** | **Number of Assignments** | **% of Grade** |
|---|---|---|
| Resume Assignment | 1 | 2 |
| Reading Assignments | 5 | 10 |
| Discussions | 4 | 8 |
| Programming Assignments | 7 | 35 |
| Final Project | | |
| Proposal | 1 | 4 |
| Data & Technology Report | 1 | 5 |
| Presentation | 1 | 5 |
| Application Implementation | 1 | 15 |
| Final Report | 1 | 10 |
| Video | 2 | 6 |
| **Total** | **24** | **100** |

And finally, it is important to note from the outset that: (1) you 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; (2) 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 (3) no written work will be accepted for grading after 5:00 p.m. PT on the last day of classes (i.e.3rd December, 2015).

## 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.

### Additional Policies

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 multiple 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 e-mail through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all e-mail 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 e-mails from students relatively quickly, I will endeavor to respond to all e-mail 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 e-mail 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 12-15 hours per week completing the work in this course.

## Course Schedule (Tentative)

| | **Topics/Daily Activities** | **Readings and Homework** | **Deliverables/Due Dates** |
|---|---|---|---|
| **Week 1**<br>8/24 | **Introduction**<br>Introduction to the course | Fu&Sun (2011) – Ch.1<br>Berners-Lee (1996)<br>Jones & Purves (2008)<br>Wang et al. (2013)<br>Setting up your web production environment | Reading Assignment 1<br>Programming Assignment 1<br>Student Resume |
| **Week 2**<br>8/31 | **Web Page Basics – Part 1**<br>The basics of internet scripting languages, and creating basic web pages | Lynda.com HTML: Williamson (2014) & Javascript: Allardice (2011)<br>Introductions to web page scripting using HTML5 and JavaScript | Programming Assignment 2 – Part 1 |
| **Week 3**<br>9/7 | **Web Page Basics – Part 2**<br>Overview of popular proprietary and open source Web GIS software | Lynda.com Jquery: Marini (2015) & CSS: Williamson (2012)<br>Introductions to JQuery and CSS | Discussion 1<br>Programming Assignment 2 – Part 2 |

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|---|---|---|---|
| **Week 4**<br>9/14 | **Web Mapping Basics – Part 1**<br>Introduction to the Google Maps API and the uses of various web scripting languages | Fu&Sun (2011) – Ch.2<br>Petroutsos (2015), Ch.1,2,4-7,10<br>Peng and Tsou (2003)<br>Introduction to Google Maps | Reading Assignment 2<br>Programming Assignment3 – Part 1 |
| **Week 5**<br>9/21 | **Web Mapping Basics – Part 2**<br>Introduction to creating web maps embedded in web pages using Google Maps | Petroutsos (2015), Ch.11-14,16,17,19,20<br>Creating Web Apps w/the Google Maps API | Discussion 2<br>Programming Assignment 3 – Part 2<br>Project Proposal Meeting |
| **Week 6**<br>9/28 | **Geospatial Web Services – Part 1**<br>Introduction to geospatial web services and Esri ArcGIS Server in a virtual environment | Fu&Sun (2011) – Ch.3<br>Petroutsos (2015) - Ch.15<br>Zhao, Forester & Yue (2012)<br>Esri Services & GeoNet: Introduction to ArcGIS Server | Reading Assignment 3<br>Programming Assignment 4 – Part 1 |
| **Week 7**<br>10/5 | **Geospatial Web Services – Part 2**<br>Working with Esri ArcGIS Server and integration with Esri ArcGIS.com | Petroutsos (2015) - Ch.18<br>Visualizing large data sets & Esri GitHub & Templates: Esri ArcGIS Server and ArcGIS.com Organizations | Discussion 3<br>Programming Assignment 4 – Part 2 |
| **Week 8**<br>10/12 | **Geospatial Mashups**<br>The basics of Web GIS mashups and the current "open season" using Web 2. Approaches for creating advanced applications using the Esri ArcGIS Server JavaScript AP | Fu&Sun (2011) – Ch.4<br>Elwood, Goodchild, & Sui (2012)<br>Lin (2013)<br>Esri ArcGIS for Developers: Creating Web Apps w/ArcGIS Server JavaScript API | Reading Assignment 4<br>Programming Assignment 5 |
| **Week 9**<br>10/19 | **Geoportals & NSDI**<br>Introduction to Geoportals, NSDI and spatial geodatabases using Esri ArcGIS Server. Advances in creating Volunteered Geographic Information Web GIS applications | Fu&Sun (2011) – Ch.6&7<br>Goodchild (2008),<br>Esri Geodata: Creating Enterprise SQL Server Databases for ArcGIS Server Services – Web Editing/VGI Apps | Reading Assignment 5<br>Project Proposal |
| **Week 10**<br>10/26 | **Web GIS Applications In the Cloud**<br>Developing Web GIS applications in the cloud, and critical assessment of the benefits and challenges of cloud vs local virtual environments | Fu&Sun (2011) – Ch.8<br>Introduction to the Amazon EC2 (instance, a VM) & Amazon Machine Image (AMI) | Programming Assignment 6 |

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|---|---|---|---|
| **Week 11**<br>11/2 | **Web GIS Applications And ArcGIS.com**<br>The intersection of Esri ArcGIS Server, ArcGIS.com and cloud-based computing | Fu&Sun (2011) – Ch.9<br>Esri ArcGIS Server on Amazon EC2 - ArcGIS Server & Geospatial Data in the Cloud | Programming Assignment 7 –Part 1 |
| **Week 12**<br>11/9 | **The Future of Web GIS**<br>Evaluating current open source and proprietary technologies that support Web GIS and how these might shape the future of Web GIS application development | Fu&Sun (2011) – Ch.10,<br>Holman (2012), Blogs: Future of Web Mapping via Open Source<br>CyberGIS, Google, Esri, & Feedback and Evaluations | Programming Assignment 7 –Part 2 |
| **Week 13**<br>11/16 | **Work on Final Project**<br>Implementation of a unique Web GIS application project | Prepare Data & Technology Report documenting Web GIS software and data chosen for the Final Project | Data & Technology Report |
| **Week 14**<br>11/23 | **Work on Final Project**<br>Continue to work on Final Project | Thanksgiving break (25-28) | Discussion 4 |
| **Week 15**<br>11/30 | **Complete Final Project**<br>Complete final project presentation, report and video | Conduct final presentation and live demonstration of Web GIS application project<br>All work must be submitted by 5:00 p.m. PT on Fri 3rd Dec, the last day of classes | Final Project Presentation<br>Application Implementation<br>Final Project Report<br>Final Project Videos |

## 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://scampus.usc.edu/b/11-00-behavior-violating-university-standards-and-appropriate-sanctions/. 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://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety 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 Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage 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.

***Resources for Online Students***

Our course Blackboard site provides links to several different resources that you may need. In particular, you will be making frequent use of the online USC Library that is available to all registered students through the link http://www.usc.edu/libraries. Once on this site, you can find additional resources for distance students under the link "Library Services". Many other resources and links to key people you may need to contact are also listed on the Blackboard site under Other Resources and Contacts.