SSCI 580 (35890), Spatial Computing

Units: 4

Term — Day — Time: Fall, 2016; Wednesdays and Fridays; 12:00 p.m. – 1:50 p.m.

Location: AHF 145D

Instructor: Wei Yang, Ph.D.
Office: AHF B55A
Office Hours: Wednesdays and Fridays 2:00 - 3:00 p.m. PT; also available most other days by appointment via email
Contact Info: yang474@usc.edu; 213-740-2835
BlueJeans: https://bluejeans.com/4900531065/

Library Help: Katharin Peter
Office: VKC B40a
Office Hours: by appointment
Contact Info: kpeter@usc.edu, 213-740-1700

IT Help: Richard Tsung
Office: AHF 146
Office Hours: by appointment
Contact Info: gistsupport@usc.edu, 213-821-4415
Course Description
This class will cover the theoretical foundations, methods, techniques, and software systems for spatial computing. This includes the latest research in a variety of topics that are central to spatial computing, including the geospatial semantic web, geospatial mashups, spatial data mining, geocoding, location-based services, volunteered geographic information. Students will also gain a deep understanding and hands-on experience in the software for spatial computing, including geographic information systems (e.g., ArcGIS), Geospatial mashups (e.g., Bing Maps, Google Earth), Open Source Software (e.g., QGIS, PostGIS), Python packages related to geospatial analysis (e.g., Tweepy, Geopy, Geoparsing). Students will learn about the wide variety of geospatial data and services available, including how to find relevant data and transform it as needed so that it can be used for solving specific problems.

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

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

- Describe the theoretical foundations of geospatial data and its various representations.
- Select and use the appropriate geographic information system to solve any of a variety of real-world problems.
- Build integrated applications that combine geographic data and applications for processing that data.
- Discuss the relevant spatial computing systems and techniques for working with geospatial data.
- Apply relevant spatial computing techniques to solve spatial problems.
- Critically evaluate spatial computing software and systems and determine whether they have been applied in appropriate ways.

Prerequisite(s): None
Co-Requisite(s): None
Concurrent Enrollment: None
Recommended Preparation: None

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. 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 15-minute presentation and a final report.
Technological Proficiency and Hardware/Software Required

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. 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 my immediate attention.

GIST server and tech support – This course will utilize the SSI GIST Server which is a virtual desktop. You can access the GIST Server at: http://gis-gateway.usc.edu. If you are unable to connect to the server 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.

Every student should be proficient with the MS Office suite (Excel, PowerPoint, and Word), all of which are available on the GIST Server. Documents in other software formats will not be accepted. In addition, students’ personal computer systems must meet several technology requirements:

- An up-to-date computer with a fast Internet connection.
- A functional Web camera together with a microphone or headset for live sessions.
- A modern Web browser (Firefox, IE or Chrome is 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


Accuracy Assessment in Natural Resources and Environmental Sciences, Leicester, United Kingdom: 329-332


   http://logicerror.com/semanticWeb-long
   http://infomesh.net/2001/swintro/
   367-376 in NetLibrary).
   Tenth ACM International Symposium on Advances in Geographic Information 
   Systems, McLean, Virginia: 1-4
   and Zimányi E (eds) Journal on Data Semantics III. Berlin, Springer-Verlag Lecture 
   Notes in Computer Science Vol. 3534: 1-24
38. Becker C and Bizer C (2009) Exploring the geospatial semantic web with DBpedia 
   Mobile. Web Semantics: Science, Services and Agents on the World Wide Web 7: 
   278-286
39. Koubarakis M, Kyzirakos K, Karpathiotakis M, Nikolaou Ch, Sioutis M, Garbis G, and 
   Bereta K (2012) Introduction in stRDF and stSPARQL. WWW document, 
   geospatial linked data. WWW document, 
   spatiotemporal data: Past, present, and future. Semantic Web 3: 321-332 
   (available at http://www.semantic-web-journal.net/content/geospatial- 
   semantics-and-linked-spatiotemporal-data---past-present-and-future)
   geospatial data. In Proceedings of the Sixth International Conference on 
   Geographic Information Science (GIScience 2010), Zurich, Switzerland
   geospatial reasoning. In Proceedings of the Twentieth National Conference on 
   Artificial Intelligence (AAAI '05), Pittsburgh, Pennsylvania
44. O’Brien M A and Irvine J M (2004) Information fusion for feature extraction and 
   the development of geospatial information. In Proceedings of the Seventh 
   International Conference on Information Fusion, Stockholm, Sweden
   mapping: Data integration or data fusion? International Archives of 
   Photogrammetry Remote Sensing and Spatial Information Sciences 34(4/w4): 668- 
   674


**Description and Assessment of Assignments**

Your grade in this class will be determined on the basis of several different assessment tools:

**Resume Assignment** (2%): 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** (26%): Students will be assigned weekly reading assignments.

**Class Participation** (26%): There will be weekly discussion on the lectures and reading assignments.

**Lab Assignments** (18%): Students will be assigned 5 labs during the entire semester.

**Final** (28%): Students are required to submit a final project proposal (8%) in the middle of the semester. Students will submit a final project report (10%) and make a presentation (10%) at the end of the semester.

**Grading Breakdown**

<table>
<thead>
<tr>
<th>Assignments</th>
<th>Number</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resume Assignment</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Reading Assignments</td>
<td>13</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>Class Participation</td>
<td>13</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>Lab Assignments</td>
<td>5</td>
<td>3-4</td>
<td>18</td>
</tr>
<tr>
<td>Final Project, components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Final Project Proposal</td>
<td>1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>- Final Project Presentation</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>- Final Project Report</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>35</strong></td>
<td><strong>-</strong></td>
<td><strong>100</strong></td>
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</tbody>
</table>

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

Additional Policies
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.

Course Schedule: A Weekly Breakdown

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Topics / Daily Activities</th>
<th>Readings and Homework</th>
<th>Deliverables/Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 22</td>
<td><strong>Introduction/Spatial Data Basics:</strong> Brief introductions with a discussion of class goals, technology, plans, and expectations. Basics of spatial data, incl. representations of spatial data, coordinate systems, datums, projections, etc.</td>
<td>Clark (2011) Resume Assignment Class Preparation Assignment 1 Lab Assignment 1</td>
<td>Submit Resume Assignment no later than 11:00 a.m. on Friday, Aug.24 Do Lab Assignment 1 in class on Friday, Aug.26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 2</th>
<th>Topics / Daily Activities</th>
<th>Readings and Homework</th>
<th>Deliverables/Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 29</td>
<td><strong>Geographic Information Systems:</strong> Hands-on use of ArcGIS to develop familiarity with the basic capabilities of GIS systems.</td>
<td>Clemmer (2013) Class Preparation Assignment 2</td>
<td>Submit Class Preparation Assignment 1 no later than 11:00 p.m. on Wednesday, Aug.31 Complete Lab Assignment 1 in class on Friday, Sept.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 3</th>
<th>Topics / Daily Activities</th>
<th>Readings and Homework</th>
<th>Deliverables/Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 6* *Monday, Sept.5 is a university holiday</td>
<td><strong>Spatial Data Mining:</strong> Introduction to techniques for spatial data mining.</td>
<td>Shekhar et al. (2003); Class Preparation Assignment 3 Lab Assignment 2</td>
<td>Submit Class Preparation Assignment 2 no later than 11:00 p.m. on Wednesday, Sept.7 Do Lab Assignment 2 in class on Friday, Sept.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 4</th>
<th>Topics / Daily Activities</th>
<th>Readings and Homework</th>
<th>Deliverables/Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 12</td>
<td><strong>Online GIS and Geospatial Mashups:</strong> A discussion and hands-on training with online GIS software, with a particular focus on Google Map and Google Earth.</td>
<td>Microsoft (2013) and Google (2013) Class Preparation Assignment 4</td>
<td>Submit Class Preparation Assignment 3 no later than 11:00 p.m. on Wednesday, Sept.14 Complete Lab Assignment 2 in class on Friday, Sept.16</td>
</tr>
</tbody>
</table>
| Week 5 | Sept. 19 | **Volunteered Geographic Information (VGI):** Recent developments in volunteered geographic information (VGI), including the widely used sources, techniques for crowd-sourcing data, and attempts to evaluate the quality of VGI data. | Wong & Hong (2007); Intel (2012); Tuchinda et al. (2008); Gupta & Knoblock (2010); Wang et al. (2009); Jiang (2012); Goodchild & Li (2012) | Submit Class Preparation Assignment 4 no later than 11:00 p.m. on Wednesday, Sept.21
Do Lab Assignment 3 in class on Friday, Sept.23 |
| Week 6 | Sept. 26 | **Location-based Services and Privacy:** Various features of successful modeling applications, including the need for authenticity (i.e., the evaluation of the model relative to the real system), parsimony (i.e., the desirability of keeping things simple and avoiding unnecessary complications), transparency (i.e., the need for clear documentation and user-friendly organization of both the model and the documentation), and patience (i.e., the fact that it takes time to construct and/or implement a model). | Junglas & Watson (2008); Dey & Abowd (2000); Myles et al. (2003) | Submit Class Preparation Assignment 5 no later than 11:00 p.m. on Wednesday, Sept.28
Complete Lab Assignment 3 in class on Friday, Sept.30
Discuss Final Project Proposal in class on Friday, Sept.30 |
| Week 7 | Oct. 3 | **Geocoding:** Methods and approaches to linking addresses to location | Bakshi et al. (2004); Goldberg & Cockburn (2010); Goldberg et al. (2007, 2010); Davis et al. (2003); Zandbergen (2008) | Submit Class Preparation Assignment 6 no later than 11:00 p.m. on Wednesday, Oct.5
Do Lab Assignment 4 in class on Friday, Oct.7 |

Introduction to the research, tools, and techniques for building online integrated applications with geospatial data, focusing on the ability to rapidly compose new applications from available sources and services.
<table>
<thead>
<tr>
<th>Week 8</th>
<th>Oct. 10</th>
<th><strong>Linking Text to Location:</strong> Methods and approaches for linking textual information to geographic locations.</th>
<th>Knoblock (2012); Lieberman et al. (2007, 2010); Amitay et al. (2004); Rauch et al. (2003); McCurley (2001); Ouercini et al. (2010)</th>
<th>Submit Class Preparation Assignment 7 no later than 11:00 p.m. on Wednesday, Oct.12</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Class Preparation Assignment 8</td>
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<td>Complete Lab Assignment 4 in class on Friday, Oct.14</td>
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<tr>
<td>Week 9</td>
<td>Oct. 17</td>
<td><strong>Geospatial Semantic Web Basics:</strong> Semantic Web basics of representing and querying data. Methods for representing and reasoning about geospatial data using the infrastructure of the Semantic Web.</td>
<td>Manola &amp; Miller (2004); W3C (2004); Harris &amp; Seaborne (2012); Markus et al. (2012); Swartz (2002); Palmer (2001); Fonseca (2008); Egenhofer (2002); Kuhn (2005); Becker &amp; Bizer (2009)</td>
<td>Submit Class Preparation Assignment 8 no later than 11:00 p.m. on Wednesday, Oct.19</td>
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<td>Class Preparation Assignment 9</td>
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<td>Do Lab Assignment 5 in class on Friday, Oct.21</td>
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<td></td>
<td></td>
<td>Lab Assignment 5</td>
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</tr>
<tr>
<td>Week 10</td>
<td>Oct. 24</td>
<td><strong>Geospatial Linked Data:</strong> Research and techniques for creating and using geospatial linked data.</td>
<td>Koubarakis et al. (2012); Parundekar et al. (2010); Janowicz et al. (2012)</td>
<td>Submit Class Preparation Assignment 9 no later than 11:00 p.m. on Wednesday, Oct.26</td>
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<td>Class Preparation Assignment 10</td>
<td></td>
<td>Complete Lab Assignment 5 in class on Friday, Oct.28</td>
</tr>
<tr>
<td>Week 11</td>
<td>Oct. 31</td>
<td><strong>Spatial Data Reasoning:</strong> Introduction to techniques for spatial data reasoning.</td>
<td>Gupta &amp; Knoblock (2010); Michalowski &amp; Knoblock (2005); O’Brien &amp; Irvine (2004); Savopol &amp; Armenakis (2002)</td>
<td>Submit Class Preparation Assignment 10 no later than 11:00 p.m. on Wednesday, Nov.2</td>
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<td>Class Preparation Assignment 11</td>
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<td>Discuss and Prepare Final Project in class on Friday, Nov.4</td>
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<tr>
<td>Week 12</td>
<td>Nov. 7</td>
<td><strong>Registering and Aligning Geospatial Layers:</strong> Discussion of techniques for automatically aligning various geospatial layers, including both vector and raster layers.</td>
<td>Chen et al. (2006, 2008); Wu et al. (2007); Zitova (2003)</td>
<td>Submit Class Preparation Assignment 11 no later than 11:00 p.m. on Wednesday, Nov.9</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Week 13</th>
<th>Final Project Presentation</th>
<th>Final Project Presentation</th>
<th>Submit Class Preparation Assignment 12 no later than 11:00 p.m. on Wednesday, Nov.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 14</td>
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<td>Discuss and Prepare Final Project in class on Wednesday, Nov. 16</td>
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<td></td>
<td></td>
<td>Complete Final Project Presentation on Fri. Nov.18</td>
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**Week 14**

<table>
<thead>
<tr>
<th>Week 14</th>
<th>Final Project Preparation</th>
<th>Prepare Final Project Report</th>
<th>Prepare Final Project Report (Thanksgiving)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 21*</td>
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<tr>
<td>*Thursday, Nov. 24 and Friday Nov. 25 are university holidays</td>
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**Week 15**

<table>
<thead>
<tr>
<th>Week 15</th>
<th>Final Project Report</th>
<th>Prepare Final Project Report</th>
<th>Submit Final Report no later than 11:00 p.m. on Friday, Dec.2</th>
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<tbody>
<tr>
<td>Nov. 28</td>
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**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/1100-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://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 Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ 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.