SSCI 382, Principles of Geographic Information Science

Units: 4  
Term-Day-Time: Spring 2015, Mon./Wed., 2:00 – 3:20 p.m.  
Location: Spatial Sciences Institute, AHF 57A

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Hours of Service: Mon.-Fri. 9 am. – 5 p.m. PT  
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Course Description

The spatial sciences focus on the various ways in which Geography can be used to acquire, represent, organize, analyze, model and visualize information. These views of the world are supported by Geographic Information Systems (GIS) and the related geospatial technologies (GPS, remote sensing systems, etc.) which, in turn, rely on the underlying Geographic information science concepts and methods. This much is known from SSCI 301L: Maps and Spatial Reasoning and this particular course (the second in a three-course sequence) seek to elucidate how these systems and the underlying science provides a gateway to the natural and social sciences and problem-solving in general.

That said, a large part of the course is focused on various kinds of spatial analysis since they constitute the crux of GIS, providing the means of adding value to Geographic data and for turning these data into useful information. Numerous examples will be used throughout the course to illustrate how spatial analysis helps us in situations when our eyes might deceive us and/or to reveal things that might otherwise be invisible. The combination of class and
laboratory sessions will show how effective spatial analysis requires an informed and intelligent user in addition to the appropriate computer hardware and software tools.

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

**Learning Objectives**

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

- Recognize Geographic data and what is special about it and why it is important.
- Discuss the kinds of decisions made with Geographic information.
- Understand how scientists, managers and policy makers use Geographic Information Systems, and why they find it helpful.
- Discuss what constitutes a Geographic Information System and how managers and policy makers would know one if they saw it.
- Explain how modern Geographic analysis and visualization tools can be used to advance our knowledge and understanding of human and environmental activities and events from a variety of disciplinary perspectives.

**Prerequisite(s):** None

**Co-Requisite (s):** None

**Concurrent Enrollment:** None

**Recommended Preparation:** SSCI 301: Maps and Spatial Reasoning. Student enrolled in GeoDesign major or Spatial Studies Minor.

**Course Structure**

This course will unfold on a weekly basis. Each week will be focused on a particular aspect of Geographic Information Science, delivered through lectures, hands-on computer lab assignments and field data-gathering exercises. In order to facilitate collaboration, for some assignments the class will be divided into small groups to work on assignments. Group members will share each other’s work and present results in Blackboard Discussion threads that will be shared with the entire class.
Technological Proficiency and Hardware/Software Requirements

GIS and Geospatial Data - The GIS software and geospatial data required for the course assignments will be accessed using computing resources provided by the Spatial Sciences Institute. We have several additional technologies that will facilitate our course:

Blackboard – All course materials 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 weekly flow of the course will be recorded.

Discussion boards – On the Blackboard site, we will have several discussion threads related to various course topics. These threads will provide an opportunity to collaborate on computer lab assignments, for example to facilitate group work or offer helpful tips to each other. I will check the discussion threads and offer occasional comments. Please send your course instructor an email directly if you have a question or concern that requires immediate attention.

Required Readings and Supplementary Materials

The required textbooks for this course are:


The recommended (optional) textbooks for this course are:


Description and Assessment of Assignments

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

Lab Assignments (26%) – There are fourteen labs in this class. Each lab assignment is completed in the weekly two-hour lab session, led by the Instructor. In order to demonstrate that you understand the basic concepts and skills learned in the class, you will utilize your knowledge of Geographic Information Science to complete hands-on assignments that involve the use of GIS.

Spatial Analysis Projects (30%) - Hands-on individual and group projects will be used to practice the techniques explored in theory and in the laboratory assignments. At the completion of each project, you will turn in some digital output to demonstrate that you have completed it.

Mid-term Examination (14%) - The mid-term exam in this class covers material all parts of the class, including lectures, labs, and readings, covered between the start of the semester until the date of the mid-term exam.
Final Examination (30%) - The final exam in this class covers material from all parts of the class, including lectures, labs, and readings, spread across the entire semester.

Grading Breakdown

The table below summarizes the SSCI 382 course assessments and their point distribution:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Points</th>
<th>% of Grade</th>
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<tbody>
<tr>
<td>Lab Assignments</td>
<td>26</td>
<td>26</td>
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<tr>
<td>Spatial Analysis Projects</td>
<td>30</td>
<td>30</td>
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<tr>
<td>Mid-term Examination</td>
<td>14</td>
<td>14</td>
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<tr>
<td>Final Examination</td>
<td>30</td>
<td>30</td>
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<td>Total</td>
<td>100</td>
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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 to Blackboard before the deadlines detailed in the Course Schedule. Late work will be assessed a penalty of 10% per day and zero grades will be assigned for work that is more than one week late.

Each of the lab sessions will start on the hour with a brief introduction from the instructor. These introductions will take no longer than 10 minutes and students arriving more than 10 minutes after the scheduled start times for their laboratory sessions will be turned away and assigned a zero grade for that particular lab assignment. Self-guided or group work tasks using one or more geospatial datasets will then follow for approximately an hour after which time the instructor will convene a 15-minute roundtable discussion of what you have done, what it means, and how these tasks might have been varied and/or enhanced if performed by professionals in a real world setting. The final 30 minutes of the lab sessions will be available for each of you to prepare and submit your final lab report for grading. No lab assignments will be accepted for grading if handed in outside of the regularly scheduled lab session. Students must purchase and use their own copies of the lab textbook.
Course Schedule (Tentative)

The course will be organized around the following five modules and the accompanying lecture and laboratory topics. The labs will be organized around the lab topics as shown in the Course Schedule below. The dates shown to the left of the individual topics indicate the Monday or Tuesday on which these labs start, and are due the same day the lab is conducted.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics/Daily Activities</th>
<th>Readings and Assignments</th>
<th>Deliverables/Due Dates</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td><strong>Introduction to the Course</strong>&lt;br&gt;Brief introductions coupled with discussions of class goals, lab assignments, projects, and technology.&lt;br&gt;<strong>Geographic Information Science</strong>&lt;br&gt;Introduction to the Geographic Information Science and Geographic Information Systems.</td>
<td>Longley et al. (2011) <em>Geographic Information Systems and Science</em> (3rd Ed) (Ch. 1 &amp; 2, pp. 1-71)&lt;br&gt;Law &amp; Collins (2013) <em>Getting to Know ArcGIS Desktop</em> (3rd Ed) (Ch. 1 &amp; 2, pp. 3-27)</td>
<td>Lab: Introduction to GIS &amp; Geographic Information Science</td>
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<td>1/12</td>
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<tr>
<td>1/14</td>
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<td>1/12</td>
<td><strong>Representing Geography &amp; Nature of Geographic Data</strong>&lt;br&gt;Discussion of the concept of representation of a digital model of the earth’s surface, and what is special about “spatial” in terms of geographic data.</td>
<td>Longley et al. (2011) <em>Geographic Information Systems and Science</em> (3rd Ed) (Ch. 3 &amp; 4, pp. 73-121)&lt;br&gt;Law &amp; Collins (2013) <em>Getting to Know ArcGIS Desktop</em> (3rd Ed) (Ch. 3 &amp; 4, pp. 31-118)</td>
<td>Lab: Getting Started with Maps and Data: Interacting with Maps &amp; Data</td>
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<td>1/21</td>
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<td>1/22, 23</td>
<td>Engaging Professionals&lt;br&gt;Attend the Ersi Geodesign Summit in Redlands, CA.</td>
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<td>Week 3</td>
<td><strong>Georeferencing</strong>&lt;br&gt;Discussion of geographic location, projections and coordinates&lt;br&gt;<strong>Geotagging &amp; Mashups</strong>&lt;br&gt;Discussions of geospatial metadata, and how web mashups are created.</td>
<td>Longley et al. (2011) <em>Geographic Information Systems and Science</em> (3rd Ed) (Ch. 5, pp. 123-145)&lt;br&gt;Law &amp; Collins (2013) <em>Getting to Know ArcGIS Desktop</em> (3rd Ed) (Ch. 5 &amp; 6, pp. 119-202)</td>
<td>Lab: Getting Started with Maps and Data: Coordinate Systems and Projections, Georeferencing, and Exploring Online resources</td>
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<td>1/26</td>
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<td>1/28</td>
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<td>Week 4</td>
<td>2/2</td>
<td>Sources of Geographic Uncertainty</td>
<td>Discussion of why uncertainty arises in geographic representation and how to identify sources of uncertainty.</td>
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<th>Week 5</th>
<th>2/9</th>
<th>GIS Software</th>
<th>Discussion of what GIS software architecture consists of, the different types, and how it works.</th>
<th>Geographic Data Modeling</th>
<th>Discussion of the technical aspects and issues involved in modeling the real world in a GIS.</th>
<th>Longley et al. (2011) &lt;br&gt; <em>Geographic Information Systems and Science (3rd Ed)</em> (Ch. 7 &amp; 8, pp. 181-228)</th>
<th>Law &amp; Collins (2013) &lt;br&gt; <em>Getting to Know ArcGIS Desktop. (3rd Ed)</em> (Ch. 7 &amp; 8, pp. 203-288)</th>
<th>Lab: Displaying Data: Symbolizing and Classifying Features</th>
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<td>2/11</td>
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<th>Week 6</th>
<th>2/18</th>
<th>GIS Data Collection in Practice &amp; Acquiring Data in the Field</th>
<th>Discussion of geospatial data collection workflows, the diversity of this data, about capture techniques and how to analyze practical issues that arise in collection projects. Students work in teams to complete a project.</th>
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<th>Longley et al. (2011) &lt;br&gt; <em>Geographic Information Systems and Science (3rd Ed)</em> (Ch. 9, pp. 229-249)</th>
<th>Law &amp; Collins (2013) &lt;br&gt; <em>Getting to Know ArcGIS Desktop. (3rd Ed)</em> (Ch. 9 &amp; 10, pp. 289-377)</th>
<th>Lab: Presenting Data: Labeling Features, Making Maps for Presentation &amp; Group Project #2</th>
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| Week 7 | 2/23 | Role of Database Management Systems in GIS | Creating and Maintaining Geographic Databases | Discussions of the geographic database as the foundation of GIS, and how they are designed, built and maintained over time. | | Longley, et al. *Geographic Information Systems and Science (3rd Ed)* (Ch. 10, pp. 251-274) | Law & Collins (2013) <br> *Getting to Know ArcGIS Desktop. (3rd Ed)* (Ch. 11,12 & 13, pp. 381-456) | Lab: Creating and Editing Data: Building Geodatabases, Creating & Editing Features and Attributes |
|--------|------|----------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 2/25   |      |                                  | |                                                                                                                                    |             |                                                                                                                                       |                                                                                                               |                                                                                                               |                                                                                                               |
| Week 8 | Distributing Data and Software (GIServices)  
The Mobile User  
Discussions about how the parts of a GIS can be distributed, how geoports are created and utilized, the integration of mobile devices into our world, and service-oriented architectures that support all of these. Students work individually to complete a unique project. | Longley et al. (2011) Geographic Information Systems and Science (3rd Ed) (Ch. 11, pp. 257-294) | Lab: Data Collection, from the Field to the Lab, Independent Project #1 |
|---|---|---|---|
| Week 9 | Cartography and Map Production  
Discussions of key map design principles, the many types of symbology available, and the map production workflow. | Longley et al. Geographic Information Systems and Science (3rd Ed) (2011) (Ch.12, pp.297-322) | No deliverables. |
| 3/9 | Mid-term Exam (02:00 – 3:20 PM) |
| 3/16 | Spring Break |
| Week 10 | Geovisualization, Spatial Query and User Interaction  
Discussion about how GIS facilitates visual communication, and how virtual worlds and tools such as CityEngine can improve our understanding of the world in general.  
The Art of Geocoding  
Discussion about how to create map features from addresses, place names, and other information with a spatial component. | Longley et al. (2011) Geographic Information Systems and Science (3rd Ed) (Ch. 13, pp. 323-349)  
Law & Collins (2013) Getting to Know ArcGIS Desktop. (3rd Ed) (Ch. 14, pp.457-487) | Lab: Creating and Editing Data: Geocoding Addresses |
| 3/23 | |
| 3/25 | |
| Week 11 | Measurements  
Discussion of using attribute tables for geospatial data operations including queries, joins and relates.  
Spatial Analysis  
Discussion of spatial analysis, buffering, cluster detection, density, and interpolation. Students work individually to complete a storymap project. | Longley et al. (2011) Geographic Information Systems and Science (3rd Ed) (Ch. 14, pp.351-379)  
Law & Collins (2013) Getting to Know ArcGIS Desktop. (3rd Ed) (Ch. 15 & 16, pp. 491-571) | Lab: Getting Information about Features: Querying, Joining and Relating Data & Independent Project #2 |
| 3/30 | |
| 4/1 | |
| Week 12 | 4/6 | **Area-based Analyses**  
Discussion of methods for measuring properties of areas to characterize geographic phenomena and analyze map features. | Longley et al. (2011)  
*Geographic Information Systems and Science (3rd Ed)*  
(Ch. 15, pp. 381-401)  
Law & Collins (2013) *Getting to Know ArcGIS Desktop. (3rd Ed)*  
(Ch. 15 & 17, pp. 575-631) | Lab: Analyzing Feature Relationships: Preparing Data for Analysis |
|---------|-----|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| 4/8 | **Optimization**  
Discussion of spatial decision support and methods of statistical inference to geographic data. | | | |
| Week 13 | 4/13 | **Spatial Modeling with GIS**  
Discussion of what modeling means in the context of GIS, different types of models and potential applications, and software that supports modeling. | Longley et al. (2011)  
*Geographic Information Systems and Science (3rd Ed)*  
(Ch. 16, pp. 403-423)  
Law & Collins (2013) *Getting to Know ArcGIS Desktop. (3rd Ed)*  
(Ch. 19 & 20, pp. 633-708) | Lab: Analyzing Vector & Raster Data & Independent Project #3 |
| 4/15 | **Accuracy and Validity in Models**  
Discussion of the needs of modeling, understanding model validity and how this can be addressed using current GIS Software. Students work individually to complete a unique project. | | | |
| **Earth Day Event at USC** | | | | |
| Week 14 | 4/20 | **Managing GIS**  
Discussion of GIS project management, applied to an example spatial analysis project.  
**GIS Operational Challenges**  
Discussion of the operational challenges involving use of GIS by individuals, academia, small versus large organizations. Students work in teams on a project involving field data acquisition using i.e. Collector for ArcGIS, perform data analysis, map production, and produce group storymaps. | Longley et al. (2011)  
*Geographic Information Systems and Science (3rd Ed)*  
(Ch. 17 & 18, pp. 427-476) | Lab: Exploring Spatial Patterns in Your Data, Group Project #3 |
| 4/22 | | | | |
### 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/](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/](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/](http://equity.usc.edu/) or to the *Department of Public Safety* [http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us](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/](http://www.usc.edu/student-affairs/cwm/) provides 24/7 confidential support, and the sexual assault resource center webpage [sarc@usc.edu](mailto: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/](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.