SSCI 581 (35892), Concepts for Spatial Thinking

Syllabus

Units: 4

Term — Day — Time: Spring 2018, Mondays and Wednesdays, 12:00 to 1:50 p.m. PT

Location: AHF 145D

Instructor: Katsuhiko “Kirk” Oda, Ph.D, GISP
Office: AHF B56B
Office Hours: Mondays 2:00 to 3:00 p.m. PT and Wednesdays 11:00 a.m. to 12:00 p.m. PT. Also available most days and times by appointment via email.
Contact Info: katsuhio@usc.edu, 213-740-2868 (office), https://bluejeans.com/2137402868

Library Help: Andy Rutkowski
Office: VKC 36B
Office Hours: Tuesdays 10:00 a.m. to 12:00 p.m. PT and Thursdays 4:30 to 5:30 p.m. PT

IT Help: Richard Tsung
Office: AHF 146
Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)
Course Scope and Purpose

This course is an introduction to geographic information science and the cartographic and geographic concepts underlying spatial thinking and the accompanying geospatial technologies.

The course is designed to serve several audiences given its role as a required entrée course for five distance learning programs – the M.S. in Geographic Information Science & Technology (GIST) and the M.S. in Human Security and Geospatial Intelligence, the GIST and Geospatial Intelligence Graduate Certificates, and the GeoHealth track in the Keck School of Medicine’s Master of Public Health program – and three residential programs, the M.S. in Spatial Data Science, the M.S. in Spatial Economics and Data Analysis, and the M.S. in Transportation Systems Management. Students are provided with a variety of options in the assignments so they can align the geospatial data, analysis, and visualization tasks with their own academic interests and objectives.

Residential students are encouraged to take the residential face-to-face classes but can take the online class if they need to and vice versa, online students might take the residential face-to-face class if they wish to.

Looking beyond these specific audiences and the mode of instruction, this is a course designed for those who wish to improve their GIS skills and understand the underlying concepts. In addition to the theoretical underpinnings, students will gain an understanding of the fundamentals of geographic information science including spatial analysis, coordinate systems, and cartography, and the ways in which Esri’s ArcGIS ecosystem enables analysis, modeling and visualization.

Spatial thinking – Despite Thomas Friedman’s argument that “the world is flat”, place remains critically important, perhaps more than ever, in contemporary society. We will start by exploring why spatial thinking is important for describing, analyzing, modeling and visualizing our world and how the "habit" of spatial thinking can be encouraged and cultivated. We will use a series of readings, self-directed activities, and case studies that show how spatial thinking permeates and supports various kinds of problem solving.

Geodesy – Geodesy is the branch of science concerned with the size and shape of the Earth and determining precise locations on its surface. The major topics to be covered – geodetic datums, geoids, coordinate systems, and map projections – underlie all that follows in our programs and the successful deployment and use of geospatial technologies.

Fundamentals of GIS – The evolving field of geographic information science is a core component of the course. We will explore the relationships between geographic information science and other disciplines in the natural and social sciences, humanities, engineering, and professions (e.g., architecture, health, journalism, and social work).

The ArcGIS Ecosystem – We will explore how ArcGIS software can be used to represent space and analyze spatial questions through a series of tutorials that cover different types of geospatial data, raster and vector data models, coordinate systems, map projections, geoprocessing, and raster analysis.
Maps – Maps have been used throughout history to aggregate and communicate geographic concepts and relationships. Once the domain of professional cartographers, maps can now be authored and shared by nearly anyone through GIS and the internet. We will review past, present, and future map use and how maps can depict and communicate geographic knowledge in a digital age.

Spatial Data – The ability to understand and analyze data sets is an essential component of GIS. We will investigate fundamental geospatial datasets (e.g. the US Census) and attain the knowledge and skills necessary for processing, interpreting, and analyzing GIS data.

This is a graduate level course, and at the graduate level you are responsible for your own learning. The instructor’s role is as a guide on the path of academic exploration, and you will be rewarded by deeply engaging with your fellow classmates. You will be intellectually challenged throughout the term, as you engage with the course content and explore ideas, opinions, and analysis, perhaps different from those you held coming in. Learning arises from active participation with the reading materials and with one another. The challenge for the instructor is to provide a robust, challenging, and stimulating academic experience within the milieu of the digital era.

All course materials will be organized through the Blackboard Course Management System. Core theoretical concepts will be provided via course notes and assigned readings. Written assignments will give students an opportunity to analyze and apply the concepts and theory learned from readings. Presenting the course notes and assigned readings again in class would simply consume your precious time. Instead, you are required to read the texts and course notes before you come to the classroom and discuss what concepts you thought the most challenging to understand. This allows you to engage in internalizing and applying the concepts and theory learned from readings for a deeper understanding of our course materials. In addition, you will work with your classmates together and actively interact by sharing experiences through collaborative learning. All will benefit from the aforementioned course format. Practical exercises will mainly use ArcGIS Pro.

**Learning Outcomes**

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

- Acknowledge and utilize spatial thinking for geospatial analysis and visualization.
- Understand and be able to apply fundamental spatial concepts such as arrangement, orientation, diffusion, dispersion, and pattern.
- Explain and apply exemplary cartographic principles. Demonstrate how maps have been used throughout history to organize and empower different groups of people. Anticipate the evolution of maps in the future.
- Explain the role and importance of geodetic datums, geoids, coordinate systems, and map projections for identifying position and the location of places, people, and features on the Earth’s surface.
- Gain an in-depth understanding of how spatial analysis, modeling, and visualization tools included in geographic information systems and other geospatial technologies can
be used to advance knowledge creation and communication across a variety of disciplines.

- Process, assess, and describe core geospatial datasets such as census data.
- Conduct a GIS project for real-world decision-making through geographic inquiry.

**Prerequisite(s):** None  
**Co-Requisite(s):** None  
**Recommended Preparation:** None

### 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 (DSL at a minimum).
- A functional webcam for use whenever a presentation or meeting is scheduled.

**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 technical issues, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu, making sure to copy (cc) your instructor on the email.

**Communications** – All materials will be provided via Blackboard. This allows you to engage in reading and class preparation assignments individually before you come to the classroom. 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.

Your instructor is regularly online and will respond to student emails quickly. All email will be responded to within 24 hours of receipt, with no more than 72 hours delay. In the rare case when your instructor will be offline for 72 hours or more, an announcement will be posted on the Blackboard site.

### Required Readings and Supplementary Materials

**Textbooks** – There are seven texts for this course, though you are not required to purchase all of them. They are available from the USC Bookstore or online outlets such as Amazon. For further information on the Bolstad text, visit the following page: [http://www.paulbolstad.net/gisbook.html](http://www.paulbolstad.net/gisbook.html). Make sure to obtain the correct editions of the texts. Textbooks will be supplemented with Course Notes and readings from academic journals, professional reports and reputable websites.

**Course texts (Students must purchase):**


Other textbook excerpts (Excerpts will be supplied or available for download - students do not need to purchase)

Academic Articles – Additional readings that focus on topics relevant to course themes will be provided through Blackboard.


**Description and Assessment of Assignments**

**Weekly Assignments**

There are several different types of weekly assignments, which are further described in the “Weekly Assignments” folders on Blackboard.

**Resume Assignment – 1 worth 1 point.** All students are required to post and maintain a public resume, biography, and headshot on our SSI Student Community Blackboard site. Unless you opt out, your resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is used to both promote our program and your skills, experience and professional aspirations.

**Access SSI Server Tutorial – 1 worth 1 point.** The SSI Server will be used frequently throughout the semester, so you must ensure access during the first week.

**Discussion Forums – 3 worth a total of 6 points.** Discussions will include an introduction, a spatial thinking activity, and an opportunity to reflect on and evaluate select aspects of the course. All students are expected to engage in these elements with their classmates.

**Reading Quizzes – 10 worth of a total of 4 points.** These short open-book quizzes emphasize key points from the readings.

**Written Assignments – 5 worth of a total of 15 points.** It is critical that graduate students be well-versed in the discussions, debates, and normative frameworks that define their field. Five written assignments will be included in this course, focused on the theoretical aspects of spatial thinking and reasoning, with the objective of enabling students to critically examine and reflect on the course readings. All of the assignments are required. In each of the written assignments except the first one, students will select one article from a set of readings to review for their submission.

**Geodesy Quiz – 1 worth of 5 points.** A quiz will be administered at the end of the geodesy module and allow you to demonstrate your knowledge and understanding of geodetic datums, coordinate systems, and map projections.

**ArcGIS Tutorials – 5 worth of a total of 15 points.** The ArcGIS tutorials are intended to familiarize students with using ArcGIS Pro, and apply their skills to problem scenarios. Students will work through Law and Collins’ *Getting to Know ArcGIS Pro* workbook and Esri
web courses, and then be asked to solve basic research problems by using the skills acquired from each module. A written report will be required for each tutorial. A student-led discussion forum will allow students to ask questions and share information with one another.

**GIS Data Tutorials – 3 worth of a total of 15 points.** In this set of tutorials, students study, collect, and learn techniques for processing spatial data. Data sets include U.S. Census data, elevation, hydrography, land cover, and transportation networks. Students will describe the properties of the obtained data including the spatial and temporal granularity, measurement scales, sample design, and suitability for future applications.

**Final Project**

The Final Project is the opportunity to integrate the theoretical concepts and technical skills learned throughout the semester by framing a geospatial question for decision support in a topic connected with each student’s academic path. This includes, but is not limited to, GeoHealth, Landscape Architecture, Historical Preservation, Economic Geography, Spatial Informatics, GeoIntelligence, Engineering, and general topics related to natural and social sciences. Students will identify and locate the appropriate spatial and non-spatial data sources, import data into ArcGIS, and produce and interpret maps answering spatial analysis questions. To help facilitate this work, the workflow is broken up into five distinct components:

**Annotated Bibliography – 4 points.** While this is an individual project, students will begin by forming groups based on their academic interests. From there, the groups will develop an annotated bibliography to attain a broad understanding of the core theoretical concepts in their field and share resources with one another. This builds a strong intellectual background and sets the foundation for an informed and sophisticated project proposal.

**Proposal – 7 points.** Once a student has a solid foundation in their field of interest, he or she proposes a research question, as well as a table summarizing criteria for spatial analysis. An individual online meeting with the instructor to discuss the proposal is required.

**Data Report – 4 points.** A report documenting the complete set of data identified and acquired for the project.

**Final Report – 20 points.** A final report of your project (10-12 single-spaced pages including figures, maps, tables and references). More information on specifics will be included in the Final Project description.

**Final Presentation – 3 points.** Each student will deliver a presentation of the Final Project and attend the other students’ presentations during our scheduled final exam. With student consent, these will be captured and shared with the broader spatial science community.

**Grading Breakdown**

Careful planning and a serious, consistent commitment will be required for you to successfully navigate the various deliverables in this and other SSCI courses. The table in the next page summarizes the SSCI 581 course assignments and their point distribution:
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Number</th>
<th>Points Each</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weekly Assignments</strong></td>
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<tr>
<td>Resume Assignment</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Access SSI Server Tutorial</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Discussion Forums</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Written Assignments</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Geodesy Quiz</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>ArcGIS Tutorials</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Reading Quizzes</td>
<td>10</td>
<td>0.4</td>
<td>4</td>
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<tr>
<td>GIS Data Tutorials</td>
<td>3</td>
<td>5</td>
<td>15</td>
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<tr>
<td><strong>Project Components</strong></td>
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<tr>
<td>Annotated Bibliography</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>Proposal</td>
<td>1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Data Report</td>
<td>1</td>
<td>4</td>
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<tr>
<td>Final Report</td>
<td>1</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Final Presentation</td>
<td>1</td>
<td>3</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
<td>34</td>
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<td>100</td>
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**Assignment Submission Policy**

Assignments must be submitted via Blackboard by the due dates specified in the Course Schedule. Attention to on-time assignment submission is essential. Your instructor will aim to return comments on your submitted assignments before the next one is due.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points up to FOUR days late. No points will be given for submissions more than FOUR days late. Note that all assignments worth 2 points will receive 0 points if submitted late.
- Additionally, no written work will be accepted for grading after 5 p.m. PT on the last day of classes.

*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.
## Course Schedule: A Weekly Breakdown

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Readings and Assignments</th>
<th>Deliverables and Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/20</td>
<td>Introduction</td>
<td>Harder: Ch 1 - 4&lt;br&gt;Discussion Forum 1</td>
<td>Discussion Forum 1: Monday, 8/20</td>
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<td></td>
<td>8/22</td>
<td>Introduction Cont.</td>
<td>Course Syllabus&lt;br&gt;Resume Assignment&lt;br&gt;Access SSI Server Assignment&lt;br&gt;Reading Quiz 1</td>
<td>Reading Quiz 1: Wednesday, 8/22&lt;br&gt;Access SSI Server Assignment: Wednesday, 8/22</td>
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<tr>
<td>2</td>
<td>8/27</td>
<td>Why Location Matters</td>
<td>Harder: Ch 5 - 10&lt;br&gt;Reading Quiz 2&lt;br&gt;Discussion Forum 2</td>
<td>Reading Quiz 2: Monday, 8/27&lt;br&gt;Discussion Forum 2: Monday, 8/27</td>
</tr>
<tr>
<td></td>
<td>8/29</td>
<td>Introduction to ArcGIS</td>
<td>Law: Ch 1 &amp; 2&lt;br&gt;ArcGIS Tutorial 1</td>
<td>Resume Assignment: Tuesday, 8/28</td>
</tr>
<tr>
<td>3</td>
<td>9/5</td>
<td>Spatial Thinking</td>
<td>NRC: Ch 1-3&lt;br&gt;Law: Ch 3 &amp; 10&lt;br&gt;Downs 1997&lt;br&gt;Written Assignment 1&lt;br&gt;ArcGIS Tutorial 2</td>
<td>ArcGIS Tutorial 1: Tuesday, 9/4&lt;br&gt;Written Assignment 1: Wednesday, 9/5</td>
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<tr>
<td></td>
<td>9/10</td>
<td>GIS in Decision Support</td>
<td>Cebrecos 2016&lt;br&gt;Monaco 2014&lt;br&gt;Phua et al. 2015&lt;br&gt;Zheng 2016&lt;br&gt;Written Assignment 2&lt;br&gt;Final Project Annotated Bibliography</td>
<td>No deliverables</td>
</tr>
<tr>
<td></td>
<td>9/12</td>
<td>Geoprocessing Tools</td>
<td>Law: Ch 5 &amp; 7&lt;br&gt;ArcGIS Tutorial 3</td>
<td>ArcGIS Tutorial 2: Tuesday, 9/11</td>
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<td>4</td>
<td>9/17</td>
<td>GIS Data Models</td>
<td>Bolstad: Ch 2&lt;br&gt;Reading Quiz 3</td>
<td>Reading Quiz 3: Monday, 9/17</td>
</tr>
<tr>
<td></td>
<td>9/19</td>
<td>Tools for Raster Data</td>
<td>Law: Ch 9&lt;br&gt;ArcGIS Tutorial 4</td>
<td>Written Assignment 2: Tuesday, 9/18&lt;br&gt;ArcGIS Tutorial 3: Tuesday, 9/18</td>
</tr>
<tr>
<td>5</td>
<td>9/24</td>
<td>Geodesy and Datums</td>
<td>Bolstad: Ch 3&lt;br&gt;Reading Quiz 4</td>
<td>Reading Quiz 4: Monday, 9/24</td>
</tr>
</tbody>
</table>
| Week 7 | 10/1 | Coordinate Systems & Map Projections | Bolstad: Ch 3
Reading Quiz 5
Geodesy Quiz | Reading Quiz 5: Monday, 10/1 |
|-------|------|-------------------------------------|-----------------|-----------------|
|       | 10/3 | Final Project Proposal | Final Project Proposal | ArcGIS Tutorial 5: Tuesday, 10/2
Final Project Proposal: Wednesday, 10/3 |
| Week 8 | 10/8 | Vector Analysis | Bolstad: Ch 8&9
Reading Quiz 6 | Geodesy Quiz: Monday, 10/8
Reading Quiz 6: Monday, 10/8 |
|       | 10/10 | GIS Data 1: Census Data | GIS Data Tutorial 1 | No deliverables |
| Week 9 | 10/15 | Raster Analysis | Bolstad: Ch 10
Reading Quiz 7 | Reading Quiz 7: Monday, 10/15 |
|       | 10/17 | GIS Data 2 | GIS Data Tutorial 2 | GIS Data Tutorial 1: Tuesday, 10/16 |
| Week 10 | 10/22 | GIST Domains | Duckham 2015
DiBiase et al. 2007
Reading Quiz 8 | Reading Quiz 8: Monday, 10/22 |
|       | 10/24 | GIS Data 3 | GIS Data Tutorial 3 | GIS Data Tutorial 2: Tuesday, 10/23 |
| Week 11 | 10/29 | Geographic Information Systems | Bolstad: Ch 1
Reading Quiz 9
Written Assignment 3 | Reading Quiz 9: Monday, 10/29
Written Assignment 3: Monday, 10/29 |
|       | 10/31 | Final Project Data Report | Final Project Data Report | GIS Data Tutorial 3: Tuesday, 10/30 |
| Week 12 | 11/5 | Geographic Information Science | Wilson & Fotheringham eds.: An Introduction
Goodchild 1992
Wright et al. 1997
Reitsma 2013
Written Assignment 4 | No deliverables |
|       | 11/7 | Final Project Data Report Cont. | Final Project Data Report | Final Project Data Report: Tuesday, 11/6 |
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 Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/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.

**Support Systems**

*Student Counseling Services (SCS)* – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

*National Suicide Prevention Lifeline* – 1 (800) 273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. dps.usc.edu