

SSCI 581 (35692), Concepts for Spatial Thinking

Syllabus

Units: 4

Term — Day — Time: Spring 2018, Online

Location: Online

Instructor: Su Jin Lee, Ph.D, GISP

Office: AHF B55K

Office Hours: Monday 10:00 to 11:00 a.m. and Wednesday 1:00 to 2:00 p.m. PST via Bluejeans. Please contact me via email in advance to ensure I will be online. Also available most days and times by appointment via email.

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Instructor: Katsuhiko “Kirk” Oda, Ph.D, GISP

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Library Help: Andy Rutkowski

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Course Scope and Purpose

SSCI 581, *Concepts for Spatial Thinking*, is an introduction to geographic information science and the technological, cartographic, and geographic concepts underlying spatial reasoning. Spatial is an enabling discipline. Thus, the course domain is inherently comprehensive, multi-disciplinary, and collaborative, pertinent to problem solving in a wide range of academic fields.

The course is designed to serve many audiences within the Spatial Sciences Institute and across the USC campus. It is the required entrée course for five distance learning programs (the M.S. in Geographic Information Science & Technology (GIST), 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). To accommodate and serve this wide range of academic objectives, students are provided with a variety of options in course topics and assignments so they can align the geospatial data, analysis, and visualization tasks with their own interests.

The course is taught residually and online. Residential students are encouraged to take the residential course but can take the online class if needed, and online students may take the residential course as desired.

Most fundamentally, the course is designed for any student who wishes to improve their GIS skills and understand the concepts underlying GIS analysis. In addition to the theoretical underpinnings, students will master the fundamentals of geographic information science including spatial analysis, coordinate systems, and cartography, and the ways in which Esri's ArcGIS software ecosystem enables analysis, modeling and visualization.

Fundamentals of GIS – The course provides a core foundation in the evolving field of geographic information science. We will explore the relationship between geographic information science and the fields of transportation, human security, geospatial intelligence, spatial data science, public health, economics, land use planning, geodesign, environmental science and management, spatial science, archaeology, and the humanities.

The ArcGIS Ecosystem – Esri's ArcGIS is a powerful, industry-standard software that can be used analyze spatial questions and visualize the outcome. Through a series of tutorials, students will evaluate and manipulate different types of geospatial data, raster and vector data models, coordinate systems, map projections, and geoprocessing tools, as well as conduct raster analysis. After familiarizing themselves with ArcGIS's functionality, students will develop their own spatial analysis questions and address them using their learned skill sets.

Spatial Data– The ability to understand and analyze data sets is an essential component of spatial thinking and reasoning. Students will investigate fundamental geospatial datasets such as the U.S. Census and attain the knowledge and skills necessary for processing, interpreting, and analyzing GIS data. Students will apply these skills to solving real-world spatial problems.

Spatial thinking – Location is critically important in contemporary society and a spatial perspective can be applied to nearly every topic area. The course will explore the importance of

spatial thinking for describing, analyzing, modeling, and visualizing the world, and how one can cultivate the habit of thinking spatially. The course will use readings, discussions, and a variety of case studies to demonstrate 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 the successful deployment and use of spatial technologies.

Maps – Maps have been employed throughout history to aggregate and communicate geographic concepts. Once the domain of professional cartographers, maps can now be authored and shared by nearly anyone using GIS and the internet. The course will review past, present, and future map use, and explore how maps depict and communicate geographic knowledge in the digital age.

At the graduate level, students are responsible for their own learning. Students will be intellectually challenged by the course content and through the exploration of ideas, opinions, and approaches to analysis different from their own. The instructor's role is as a guide on the path of academic exploration, and students will be rewarded through active engagement with both the material and with their fellow classmates. The challenge for the instructor is to provide a robust, challenging, and stimulating academic experience within the broader milieu of the digital era.

All course materials will be organized through the Blackboard Course Management System. Core theoretical concepts will be presented via course notes and assigned readings. Written assignments will give students the opportunity to analyze and apply the concepts and theories learned from the readings. Practical exercises will primarily use Esri's 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 – This is a distance learning course, so the majority of interactions will be asynchronous (i.e. not at the same time). All materials will be submitted via Blackboard. In addition to email about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. It is each student's responsibility to stay informed about what is going on in the course. Your instructor will send, via Blackboard, any notices that are time sensitive - please be sure to read as soon as possible. Check to be sure that email sent from the USC Blackboard account does not go into your junk mail!

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, see <http://www.paulbolstad.net/gisbook.html>.

Students should 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):

- Bolstad, Paul. *GIS fundamentals: a first text on geographic information systems*. 5th ed. Acton, MA: XanEdu, 2016.
- Law, Michael, and Amy Collins. *Getting to know ArcGIS Pro*. Redlands, CA: Esri Press, 2016.

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

- Harder, Christian. *The ArcGIS book: 10 big ideas about applying geography to your world*. Redlands, CA: Esri Press, 2015.
- Kimerling, A. Jon, Aileen Buckey, Phillip C. Muehrcke, and Juliana O. Muehrcke. *Map use: Reading, analysis, interpretation*. 8th ed. Redlands, CA: Esri Press Academic, 2016.
- Mitchell, Andy. *The Esri guide to GIS analysis: Volume 3, modeling suitability, movement, and interaction*. Redlands, CA: Esri Press, 2012.
- National Research Council. *Learning to think spatially: GIS as a support system in the K-12 curriculum*. Washington, DC: National Academies Press, 2006. (Available at http://www.nap.edu/catalog.php?record_id=11019)
- Wilson, John. P. and A. Stewart Fotheringham, (editors). *The handbook of geographic information science*. Oxford: Blackwell, 2008. (Available through the USC Libraries as an e-Book)

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

- Batty, Michael, Andrew Hudson-Smith, Richard Milton, and Andrew Crooks. "Map mashups, Web 2.0 and the GIS revolution." *Annals of GIS*, 16(1), 1-13, 2010.
- Cebrecos, Alba, Julia Díez, Pedro Gullón, Usama Bilal, Manuel Franco, and Francisco Escobar. "Characterizing physical activity and food urban environments: A GIS-based multicomponent proposal." *International Journal of Health Geographics*, 15(1), 35, 2016.
- Downs, Roger M. "The geographic eye: Seeing through GIS?" *Transactions in GIS*, 2(2), 111-121, 1997.
- DiBiase, David, Michael DeMers, Ann Johnson, Karen Kemp, Ann Taylor Luck, Brandon Plewe, and Elizabeth Wentz. "Introducing the first edition of geographic information science and technology body of knowledge." *Cartography and Geographic Information Science*, 34(2), 113-120, 2007.
- Duckham, Matt. "GI expertise." *Transactions in GIS*, 19(4), 499-515, 2015.
- Goodchild, Michael F. "Geographical information science." *International Journal of Geographical Information Systems*, 6(1), 31-45, 1992.
- Shi, Wenzhong, Michael Goodchild, Brian Lees, and Yee Leung, eds. *Advances in geo-spatial information science*. Boca Raton, FL: CRC Press, 2012.
- Kitchin, Rob and Martin Dodge. "Rethinking maps." *Progress in Human Geography*, 31, 331-334, 2007.
- Monaco, Joseph. *Supporting timely HA/DR decisions through GEOINT and GIS tools*. Fort Leavenworth, KS: School of Advanced Military Studies, 2014.
- Phua, Mui-How, and Mitsuhiro Minowa. "A GIS-based multi-criteria decision making approach to forest conservation planning at a landscape scale: A case study in the Kinabalu Area, Sabah, Malaysia." *Landscape and Urban Planning*, 71(2-4), 207-222, 2005.

- Reitsma, Femke. "Revisiting the 'Is GIScience a science?' debate (or quite possibly scientific gerrymandering)." *International Journal of Geographical Information Science*, 27(2), 211-221, 2013.
- Wright, Dawn J., Michael F. Goodchild, and James D. Proctor. "Demystifying the persistent ambiguity of GIS as 'tool' versus 'science'." *Annals of the Association of American Geographers*, 87(2), 346-362, 1997.
- Zheng, Siqi, Weizeng Sun, Jianfeng Wu, and Matthew Kahn. "Urban Agglomeration and local economic growth in China: The role of new industrial parks." *USC Dornsife Institute for New Economic Thinking*, Working Paper No. 16-06, 2016.

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 selects 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:

Assessment	Number	Points Each	Total Points
Weekly Assignments			
Resume Assignment	1	1	1
Access SSI Server Tutorial	1	1	1
Discussion Forums	3	2	6
Written Assignments	5	3	15
Geodesy Quiz	1	5	5
ArcGIS Tutorials	5	3	15
Reading Quizzes	10	0.4	4
GIS Data Tutorials	3	5	15
Project Components			
Annotated Bibliography	1	4	4
Proposal	1	7	7
Data Report	1	4	4
Final Report	1	20	20
Final Presentation	1	3	3
Total	34	-	100

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

Course Schedule: A Weekly Breakdown

	Topic	Readings	Assignments	Deliverables/Due Dates
Week 1 5/16	Introduction	Course Syllabus Harder: Ch 1-4	Resume Assignment Access SSI Server Assignment Discussion Forum 1 Reading Quiz 1	No deliverables
Week 2 5/21	Why Location Matters	Harder: Ch 5-10 Law: Ch 1&2	Reading Quiz 2 (The ArcGIS Book) Discussion Forum 2 ArcGIS Tutorial 1	Resume Assignment (5/22) Access SSI Server Assignment (5/22) Reading Quiz 1 (5/22) Discussion Forum 1 Posts (5/22) Responses to Discussion Forum 1 (5/24)
Week 3 5/29* * 5/28 is university holiday	Spatial Thinking	NRC: Ch 1-3 Downs 1997 Law: Ch 3&10	Written Assignment 1 ArcGIS Tutorial 2 Final Project Annotated Bibliography	ArcGIS Tutorial 1 (5/29) Reading Quiz 2 (The ArcGIS Book) (5/29) Discussion Forum 2 Posts (5/29) Responses to Discussion Forum 2 (5/31)
Week 4 6/4	GIS in Decision Support	Cebrecos 2016 Zheng 2016 Phua et al. 2015 Monaco, 2014 Law: Ch 5&7	ArcGIS Tutorial 3 Written Assignment 2	Written Assignment 1 (6/5) ArcGIS Tutorial 2 (6/5)
Week 5 6/11	GIS Data Models	Bolstad: Ch 2 Law: Ch 9	ArcGIS Tutorial 4 Reading Quiz 3	ArcGIS Tutorial 3 (6/12) Final Project Annotated Bibliography Posts (6/12) Written Assignment 2 (6/12)
Week 6 6/18	Geodesy and Datums	Bolstad: Ch 3	ArcGIS Tutorial 5 Final Project Proposal Geodesy Quiz Reading Quiz 4	ArcGIS Tutorial 4 (6/19) Reading Quiz 3 (6/19) Bibliography Comments/Report (6/19)
Week 7 6/25	Coordinate Systems & Map Projections	Bolstad: Ch 3	Reading Quiz 5 GIS Data Tutorial 1	Reading Quiz 4 (6/26) ArcGIS Tutorial 5 (6/26) Final Project Proposal (6/28)
Week 8* 7/2 * 7/4 is university holiday	Vector and Raster Analysis	Bolstad: Ch 9, Ch 10, 11	GIS Data Tutorial 2 Reading Quiz 6 Reading Quiz 7	Reading Quiz 5 (7/3) Geodesy Quiz (7/3) GIS Data Tutorial 1 (7/3) Responses to Proposals (7/5) Final Project Individual Meetings (TBD)

	Topic	Readings	Assignments	Deliverables/Due Dates
Week 9 7/9	GIST Domains	Duckham 2015 DiBiase et al. 2007	GIS Data Tutorial 3 Final Project Data Report Written Assignment 3 Reading Quiz 8	GIS Data Tutorial 2 (7/10) Reading Quiz 6 (7/10) Reading Quiz 7 (7/10)
Week 10 7/16	GIScience	Bolstad: Ch 1 Wilson & Fotheringham: An Introduction Goodchild 1992 Wright et al. 1997 Reitsma 2013	Written Assignment 4 Reading Quiz 9	GIS Data Tutorial 3 (7/17) Written Assignment 3 (7/17) Responses to Written Assignment 3 (7/19) Reading Quiz 8 (7/17)
Week 11 7/23	Spatial Analysis, Cartography, and the History of Maps	Bolstad: Ch 13 Mitchell: Ch 2 Kitchin & Dodge 2007 Batty et al. 2010 Goodchild 2012 Kimerling et al.: Introduction	Written Assignment 5	Reading Quiz 9 (7/24) Written Assignment 4 (7/24) Final Project Data Report (7/24) Data Report Peer Feedback (7/26)
Week 12 7/30	History and Future Trends of Maps and GIS	Bolstad: Ch 15 Wilson & Fotheringham: Ch 33&34 Slocum et al.: Ch 2	Reading Quiz 10 Discussion Forum 3	Written Assignment 5 (7/31) Project Final Report (8/2)
Week 13 8/6	Final Projects	Final Project Presentation		Reading Quiz 10 (8/7) Discussion Forum 3 Post (8/7) Final Project Presentation (8/6 & 8/7)

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

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link <https://libraries.usc.edu/>. Also, the USC Libraries have many important resources available for distance students through the link: <https://libraries.usc.edu/faculty-students/distance-learners>. This includes instructional videos, remote access to university resources, and other key contact information for distance students.