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

SSCI 581 (35692), Concepts for Spatial Thinking

Syllabus

Units: 4

Term — Day — Time: Spring 2019, Online

Location: Online

Instructor: Darren Ruddell, Ph.D. GISP
Office: AHF B57F
Office Hours: Tuesdays, 11 am-12 pm, Thursdays, 1-2 pm PT, and by appointment via email.
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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 residentially 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 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 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 how other geospatial technologies can be used to advance knowledge creation and communication across a variety of disciplines.

- Process, assess, and describe core geospatial datasets which cover a wide range of academic fields and applications.
- Conduct a GIS-based project for real-world decision-making through geographic inquiry and analysis.

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

Recommended Preparation: None

Technological and Communication Requirements

ArcGIS is provided online via the SSI Server; hence, students not need to install it on their 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 that allows access to different types of professional software. If students are unable to connect to the server or experience technical issues, they should send an email (via their USC account) to SSI Tech Support at spatial_support@usc.edu, making sure to copy (cc) the instructor on the email.

Communications – This is a distance learning course, so the majority of interactions are asynchronous (i.e. not at the same time). All assignments will be submitted via Blackboard. In addition to email about time-sensitive topics, announcements will be posted on the Blackboard Announcement page. It is each student's responsibility to stay informed as to course activities and updates. All students are in charge of ensuring that email sent from the USC Blackboard account is not directed to junk mail.

The 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 a 72 hour delay. An announcement will be posted in the rare instance when an instructor is offline for 72 hours or more.

Required Readings and Supplementary Materials

Textbooks – There are seven texts for this course, though students 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 the SSI Student Community Blackboard site. Unless a student opts out, their resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is used to both promote the program and highlight student skills, experiences, and professional aspirations.

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

Discussion Forums – 3 worth a total of 6 points. The discussions will include (1) a personal introduction, (2) an introduction to spatial thinking, and (3) an opportunity to reflect on and evaluate the course. All students are expected to post original reflections to the prompts and engage 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. Graduate students must be well-versed in the discussions, debates, and normative frameworks that define their field. The five written assignments included in this course focus on the theoretical aspects of spatial thinking and reasoning, with the objective of enabling students to critically examine and reflect upon them. To allow students to customize pursue their academic and professional interests, four of the assignments allow students to select an article of their choice from a diverse set of readings.

Geodesy Quiz – 1 worth of 5 points. The Geodesy quiz allows student to demonstrate their understanding of geodetic datums, coordinate systems, and map projections. The quiz will be administered at the end of the geodesy module.

ArcGIS Tutorials – 5 worth of a total of 15 points. The ArcGIS tutorials are intended to familiarize students with the analytical capabilities of ArcGIS Pro and apply their proficiencies to problem-solving scenarios. Students will gain skills from Law and Collins'

Getting to Know ArcGIS Pro workbook and Esri web courses, solve basic research questions, and submit a written report. Critical thinking questions will provide students an opportunity to apply their competencies to exploratory, open-ended scenarios. Should students face technical or methodological challenges, a Blackboard discussion forum allows for student-to-student dialogue.

GIS Data Tutorials – 3 worth of a total of 15 points. In the GIS data tutorials, students investigate, assemble, and master techniques for processing spatial data. Students can choose from a variety of data sets appropriate to their area of interest, including elevation, hydrography, land cover, transportation networks, and the U.S. Census. Students will come to recognize the key properties of a data set, including spatial and temporal granularity, measurement scale, sample design, and suitability for future applications.

Final Project

The course culminates with a final project, which integrates the theoretical concepts and technical skills gained during the course by applying them to a real-world geospatial question for decision support. The specific geospatial question is chosen by each student based on their academic interests. This includes, but is not limited to 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. Students will identify and locate the appropriate spatial and non-spatial data sources, import data into ArcGIS, conduct analysis, and produce and interpret maps answering spatial analysis questions. To facilitate this project, the workflow is broken up into five distinct components:

Annotated Bibliography – 4 points. As a means of familiarizing themselves with the core theoretical foundation within their area of interest, students will form small groups and develop an annotated bibliography. This will build a strong intellectual background and sets the foundation for an informed and sophisticated project proposal.

Proposal – 7 points. Once a student has a solid understanding of their field of interest, they will propose a research question and summarize the criteria needed to conduct the appropriate spatial analysis. An individual online meeting with the instructor is required to discuss the feasibility and direction of the proposal, and is a crucial component of a successful project.

Data Report – 4 points. The data report documents the key properties of the complete set of data identified and acquired for the project.

Final Report -– 20 points. The final report will be 10-12 single-spaced pages including figures, maps, tables and references. Specifics will be included in the Final Project description.

Final Presentation -– 3 points. Each student will deliver a slideshow summarizing their Final Project, similar to a “lightening talk” session at a professional or academic conference. This will occur online with a small audience of the instructor and fellow students. With student consent, these may be captured and shared with the broader spatial science community.

Grading Breakdown

Careful planning and a serious, consistent commitment will be required for students to successfully navigate the deliverables in this and other SSCI courses. The table below 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. The instructor will aim to return feedback before the next assignment 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

	Topic	Readings	Assignments	Deliverables/Due Dates
Week 1 1/7	**Introduction**	Course Syllabus Harder: Ch 1-4	Resume Assignment Access SSI Server Assignment Discussion Forum 1 Reading Quiz 1	No deliverables
Week 2 1/14	**Why Location Matters**	Harder: Ch 5-10 Law: Ch 1&2	Discussion Forum 2 Reading Quiz 2 ArcGIS Tutorial 1	Resume Assignment (1/15) Access SSI Server Assignment (1/15) Reading Quiz 1 (1/15) Discussion Forum 1 Posts (1/15) Responses to Discussion Forum 1 (1/17)
Week 3 1/22* *Monday, 1/21 is university holiday	**Spatial Thinking**	NRC: Ch 1-3 Law: Ch 3&10 Downs 1997	Written Assignment 1 ArcGIS Tutorial 2	Reading Quiz 2 (1/22) ArcGIS Tutorial 1 (1/22) Discussion Forum 2 Posts (1/22) Responses to Discussion Forum 2 (1/24)
Week 4 1/28	**GIS in Decision Support**	Law: Ch 5&7 Cebrecos 2016 Monaco 2014 Phua et al. 2015 Zheng 2016	Written Assignment 2 ArcGIS Tutorial 3 Final Project Annotated Bibliography	Written Assignment 1 (1/29) ArcGIS Tutorial 2 (1/29)
Week 5 2/4	**GIS Data Models**	Bolstad: Ch 2 Law: Ch 9	Reading Quiz 3 ArcGIS Tutorial 4	Written Assignment 2 (2/5) ArcGIS Tutorial 3 (2/5)
Week 6 2/11	**Geodesy and Datums**	Bolstad: Ch 3	Reading Quiz 4 ArcGIS Tutorial 5 Final Project Proposal	Reading Quiz 3 (2/12) ArcGIS Tutorial 4 (2/12) Annotated Bibliography Posts (2/12)
Week 7 2/19 *Monday, 2/18 is university holiday	**Coordinate Systems & Map Projections**	Bolstad: Ch 3	Reading Quiz 5 Geodesy Quiz	Reading Quiz 4 (2/19) ArcGIS Tutorial 5 (2/19) Annotated Bibliography Comments/Edits (2/19)
Week 8 2/25	**Vector Analysis**	Bolstad: Ch 8&9	Reading Quiz 6 GIS Data Tutorial 1	Reading Quiz 5 (2/26) Geodesy Quiz (2/26) Final Project Proposal Posts (2/26) Responses to Final Project Proposal (2/28)
Week 9 3/4 *3/11-3/15 is Spring Recess	**Raster Analysis**	Bolstad: Ch 10&11	Reading Quiz 7 GIS Data Tutorial 2	Reading Quiz 6 (3/5) GIS Data Tutorial 1 (3/5) Final Project Individual Meetings (TBD)

Week 10 3/17	**GIST Domains**	Duckham 2015 DiBiase et al. 2007	Reading Quiz 8 GIS Data Tutorial 3 Final Project Data Report	Reading Quiz 7 (3/18) GIS Data Tutorial 2 (3/18)
Week 11 3/25	**Geographic Information Systems**	Bolstad: Ch 1	Reading Quiz 9 Written Assignment 3	Reading Quiz 8 (3/26) GIS Data Tutorial 3 (3/26)
Week 12 4/1	**Geographic Information Science**	Wilson & Fotheringham: An Introduction Goodchild 1992 Reitsma 2013 Wright et al. 1997	Written Assignment 4 Final Project Final Report	Reading Quiz 9 (4/2) Written Assignment 3 (4/2) Final Project Data Report Posts (4/2) Responses to Final Project Data Report (4/4)
Week 13 4/8	**Maps and Spatial Analysis**	Bolstad: Ch 13 Mitchell: Ch 2 Batty et al. 2010 Goodchild 2012 Kitchin & Dodge 2007	Written Assignment 5	Written Assignment 4 (4/9)
Week 14 4/15	**Cartography and the History of Maps**	Kimerling et al.: Introduction Slocum et al.: Ch 2	Reading Quiz 10	Written Assignment 5 (4/16)
Week 15 4/22 Friday, 4/26 is the last day of class	**Future Trends of Maps and GIS**	Bolstad: Ch 15 Wilson & Fotheringham: Ch 33&34	Discussion Forum 3	Reading Quiz 10 (4/23) Discussion Forum 3: No later than 5 pm (PT) on Friday, 4/26 Final Project Final Report: No later than 5 pm (PT) on Friday, 4/26
Final Exams 5/1-5/8			Final Project Presentation	Final Project Presentation: Date and time for presentation slots will be scheduled during the class itself.

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

engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

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

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

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support – (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs – (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

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

Diversity at USC – (213) 740-2101
diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.

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. These include instructional videos, remote access to university resources, and other key contact information for distance students.