

Syllabus

Units: 4

Term - Day - Time: Fall 2021, Mon and Wed, 3:00 – 4:50 pm

Location: AHF 145A & DEN@Dornsife

Instructor: Elisabeth Sedano, JD, PhD

Office: AHF B57C

Office Hours: Mon 11 am – 12 pm and Wed 3 - 4 pm PT.
Also available by appointment via email.

Contact Info: sedano@usc.edu

Library Help: Andy Rutkowski

Office: VKC 36B

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Contact Info: arutkows@usc.edu, see contact page on Blackboard for Zoom room

IT Help: Richard Tsung

Office: AHF 145D

Office Hours: By appointment

Contact Info: spatial_support@usc.edu, 213-821-4415

Course Scope and Purpose

SSCI 581: *Concepts for Spatial Thinking*, is an introduction to geographic information science and 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 and professional fields.

The course is designed to serve many audiences within the Spatial Sciences Institute and across the USC campus. It is the foundational spatial science course for five distance-learning programs¹ and three residential programs². To serve a range of academic objectives, students are provided with a variety of options in course topics and assignments so they can align with their own academic and professional goals.

The course is also designed for any student who wishes to improve their GIS skills and understand the concepts underlying GIS analysis. Students will leave the course understanding the theoretical underpinnings of the field of spatial science.

Fundamentals of GIS – The course provides a core foundation in the evolving field of geographic information science. The course explores geographic information science and its applicability to a variety of fields, such as 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 to analyze spatial questions and visualize the outcomes. All students in this course learn how to independently use ArcGIS to solve real-world spatial questions.

Spatial Data– The ability to understand and analyze data sets is an essential component of spatial thinking, reasoning, and application. 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 also learn how to find, clean, and merge data sets and vet them for quality.

Spatial Thinking – Location is critically important in contemporary society and a spatial perspective can be applied to nearly every topic area. The course will use readings, discussions, and a variety of case studies to demonstrate the importance of spatial thinking in describing, analyzing, modeling, and visualizing the world, and how one can cultivate the habit of thinking spatially.

Geodesy – Geodesy is the branch of science concerned with the size and shape of the Earth and determining precise locations on its surface. This includes geodetic datums, geoids, coordinate systems, and map projections. Understanding what geodesy is and how it underlies the

¹The 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

²The M.S. in Spatial Data Science, the M.S. in Spatial Economics and Data Analysis, and the M.S. in Transportation Systems Management

successful deployment and use of spatial technologies separates a novice GIS practitioner with one who is more advanced.

Maps – Maps communicate the findings of spatial analysis, and have been employed throughout history to make sense of geographic concepts. The course will review past, present, and future map use, and explore how maps depict and transmit geographic knowledge in the digital age. Students will gain expertise in designing clear, communicative maps that meet professional standards.

At the graduate level, students are responsible for their own learning. 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 lectures, videos, and assigned readings. Written assignments will give students the opportunity to analyze and apply the concepts and theories learned from the readings. Projects will primarily use Esri's ArcGIS Pro.

Learning Outcomes

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

- Summarize, interpret, and utilize fundamental spatial concepts such as orientation, projections and transformations, interpolation, dispersion, and pattern.
- Examine how maps have been used throughout history to organize and empower different groups of people and anticipate the evolution of maps in the future.
- Illustrate the role and importance of geodetic datums, geoids, coordinate systems, and map projections for identifying the position and the location of places, people, and features on the Earth's surface when conducting spatial analysis.
- Describe the spatial analysis, modeling, and visualization tools included in geographic information systems and how geospatial technologies can advance knowledge creation and communication across a variety of academic disciplines and professional fields.
- Examine, analyze, and manipulate core geospatial datasets from a wide range of fields to answer original questions for real-world decision support.
- Apply appropriate academic protocol with respect to research and writing.
- Apply spatial thinking and cartographic principles in the mapping and visualization of spatial data.

Students may vary in their competency levels on these abilities. You can expect to acquire these abilities only if you honor all course policies, attend classes regularly, complete all assigned work in good faith and on time, and meet all other course expectations of you as a student.

Prerequisite(s): None

Co-Requisite(s): None

Recommended Preparation: None

Harassment, sexual misconduct, interpersonal violence, and stalking are not tolerated by the university. All faculty and most staff are considered Responsible Employees by the university and must forward all information they receive about these types of situations to the Title IX Coordinator. The Title IX Coordinator is responsible for assisting students with supportive accommodations, including academic accommodations, as well as investigating these incidents if the reporting student wants an investigation. The Title IX office is also responsible for coordinating supportive measures for transgender and nonbinary students such as faculty notifications, and more. If you need supportive accommodations you may contact the Title IX Coordinator directly (titleix@usc.edu or 213-821-8298) without sharing any personal information with me. If you would like to speak with a confidential counselor, Relationship and Sexual Violence Prevention Services (RSVP) provides 24/7 confidential support for students (213-740-9355 (WELL); press 0 after hours).

Technological and Communication Requirements

ArcGIS Pro is provided online via the SSI Server; hence, students do 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
- A functional webcam and a microphone for use whenever a presentation or meeting is scheduled
- An up-to-date-web browser to access the SSI server

If a student does not have access to any of these, please speak with the instructor at the start of the semester.

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 instructors on the email.

Communications – All materials will be provided via Blackboard. This allows you to engage in reading and class preparation assignments both ahead of synchronous sessions or asynchronously. 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 instructors are regularly online and will respond to student emails quickly. The instructors will endeavor to respond to email within 24 hours of receipt, aiming for 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

The required textbooks for this course are:

- Bolstad, Paul. 2016. *GIS Fundamentals: A First Text on Geographic Information Systems*. 6th ed. Acton, MA: XanEdu. This text is available as a hardbound copy or e-book for purchase at: www.xanedu.com.
- Law, Michael, and Amy Collins. 2020. *Getting to Know ArcGIS Pro 2.6*. Redlands, CA: Esri Press.

Supplementary readings will be assigned from various sources including but not limited to:

- Bamutaze, Y. 2019. Morphometric conditions underpinning the spatial and temporal dynamics of landslide hazards on the volcanics of Mt. Elgon, Eastern Uganda. In *Emerging Voices in Natural Hazards Research*. Edited by Rivera, F.I. Oxford: Elsevier, pp. 57-81.
- Biehl, A., Ermagun, A. and Stathopoulos, A., 2018. Community mobility MAUP-ing: A socio-spatial investigation of bikeshare demand in Chicago. *Journal of Transport Geography*, 66, 80-90.
- Bodenhamer, D.J. 2015. Narrating Space and Place. In *Deep Maps and Spatial Narratives*. Edited by Bodenhamer, D.J., Corrigan, J. and Harris, T.M. Bloomington: Indiana University Press, pp. 7–27.
- Clarke, K.C., Johnson, J.M. and Trainor, T. 2019. Contemporary American cartographic research: a review and prospective. *Cartography and Geographic Information Science*, 46(3), 196-209.
- Harley, J.B. 2001. The New Nature of Maps: Essays in the History of Cartography. Baltimore, MD: The Johns Hopkins University Press, Chapter 2.
- Huang, B. and Wang, J. 2020. Big spatial data for urban and environmental sustainability. *Geo-spatial Information Science*, 23(2), pp.125-140.
- Kanevski, M. 2013. *Advanced Mapping of Environmental Data*. Hoboken, NJ: John Wiley & Sons.
- Kimerling, A. Jon, Buckley, A.R., Muehrcke, P.C. and Muehrcke, J.O. 2016. *Map Use: Reading, Analysis, Interpretation*, 8th Ed., Redlands, CA: Esri Press.
- Levy, B.L., Phillips, N.E. and Sampson, R.J. 2020. Triple disadvantage: Neighborhood networks of everyday urban mobility and violence in US cities. *American Sociological Review*, 85(6), pp.925-956.
- Leyk, S., Gaughan, A.E., Adamo, S.B., de Sherbinin, A., Balk, D., Freire, S., ... Pesaresi, M. 2019. The spatial allocation of population: a review of large-scale gridded population data products and their fitness for use. *Earth System Science Data*, 11, 1385-1409.

- Marx, A. 2017. Using satellites to detect mass human rights violations. In *Last Lectures on the Prevention and Intervention of Genocide*. Edited by Totten, S. NY: Routledge. Ch. 23.
- Miller, H.J. and M.F. Goodchild. 2015. Data-driven geography. *GeoJournal* 80(4), 449-461.
- Salas-Olmedo, M.H., Moya-Gómez, B., García-Palomares, J.C. and Gutiérrez, J., 2018. Tourists' digital footprint in cities: Comparing Big Data sources. *Tourism Management*, 66, pp.13-25.
- Salathé, M., Bengtsson, L., Bodnar, T.J., Brewer, D.D., Brownstein, J.S., Buckee, C., ... and Vespignani, A. 2012. Digital epidemiology. *PLoS Computational Biology*, 8(7), p.e1002616.
- Sayre, N. 2005. Ecological and geographical scale: Parallels and potential for integration. *Progress in Human Geography*, 29(3), 276–290.
- Schuurman, N. 2004. *GIS: A Short Introduction*. Oxford: Blackwell, Chapter 1.
- Senaratne, H., Mobasher, A., Ali, A.L., Capineri, C. and Haklay, M. 2017. A review of volunteered geographic information quality assessment methods. *International Journal of Geographical Information Science*, 31(1), 139-167.
- Steiniger, S. and Hunter, A.J. 2013. The 2012 free and open source GIS software map – A guide to facilitate research, development, and adoption. *Computers, Environment and Urban Systems*, 39, 136-150.
- van Oort, P.A.J. 2006. *Spatial Data Quality: From Description to Application*. Thesis. Wageningen University. Rotterdam, Netherlands.
- Verplanke, J., McCall, M.K., Uberhuaga, C., Rambaldi, G. and Haklay, M. 2016. A shared perspective for PGIS and VGI. *The Cartographic Journal*, 53(4), 308-317.
- Warf, B. and Sui, D. 2010. From GIS to neogeography: Ontological implications and theories of truth, *Annals of GIS*, 16(4), 197-209.
- Zhang, X., Xu, Y., Tu, W. and Ratti, C. 2018. Do different datasets tell the same story about urban mobility — A comparative study of public transit and taxi usage. *Journal of Transport Geography*, 70, 78-90.

Description and Assessment of Assignments

There are different types of assignments, which are described in detail in the instructions posted to Blackboard.

Resume Assignments – 2 worth a total of 5 points. 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, which is used to promote the program

and highlight student skills, experiences, and professional aspirations. An updated resume will be submitted at the end of the course of study.

Projects – 5 worth a total of 45 points. The projects will be the major tool used to evaluate your learning in this course. The projects will be linked to course Modules. In support of these projects, students will complete some ArcGIS tutorials so that they are familiarized with the analytical capabilities of ArcGIS Pro and apply their proficiencies to problem-solving scenarios. Students will gain GIS skills from completing portions of the Law and Collins' *Getting to Know ArcGIS Pro* workbook and Esri web courses. In this, they will solve basic research questions, while reading, thinking, and writing about GIS projects.

Reading and Research Discussions – 5 worth a total of 20 points. These assignments call on students to critically analyze required readings, identify relevant case studies employing the methodologies and concepts we cover in class, and to discuss them with the instructor and their classmates during synchronous meetings and/or online discussion forums via Blackboard. Critical thinking questions provide students an opportunity to apply their competencies to exploratory, open-ended scenarios and support spatial thinking problem solving.

Mid-Term Exam – 1 worth of a total of 10 points. The mid-term will cover material learned in the first half of the term. It may be mixed format and may consist of multiple choice, short answer, and simple problem questions.

Final Exam – 1 worth a total of 20 points. The final exam will cover material learned over the duration of the term. It may be mixed format and may consist of multiple choice, short answer, and simple problem questions.

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
Resume Assignment 1	1	2	2
Project 1	1	5	5
Projects 2-5	4	10	40
Reading and Research Discussions	5	4	20
Resume Assignment 2	1	3	3
Mid-Term	1	10	10
Final	1	20	20
Total	14	-	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 instructors 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

Week	Topic	Assignments & Readings	Deliverables/Due Dates
Module 1: Introduction to Spatial Thinking			
Week 1 8/24	Introduction to Course and GIS Introduction to class and use of geographic information systems	Reading and Research Discussion (RRD) 1 Resume Assignment 1 Project 1 Schuurman, Ch. 1	
8/26	Fundamental Concepts The important keywords and ideas that underlie spatial reasoning	Warf and Sui	
Week 2 8/31	Spatial Data Models An introduction to vector, raster and other data models plus data and file structures	Bolstad, Ch. 2	Resume Assignment 1 – Monday, 8/30
9/2	What’s Special About Spatial? The differences between spatial and non-spatial information, including spatial autocorrelation and spatial heterogeneity	Biehl et al.	
Week 3* 9/7 *9/6 is a university holiday	Scale Introduction to the key geographic concept of scale and its importance to the real-world spatial processes and the study of them	Sayre	
Module 2: The Spatial Value Proposition			

Week	Topic	Assignments & Readings	Deliverables/Due Dates
9/9	The Power of Maps and Critical GIS The roles that maps have played throughout human history and the characteristics and uses of maps today	Harley Pavlovskaya	
Week 4 9/14	Transportation Data The spatial data used to support mobility, logistics, access, and related applications	Bolstad, Ch. 7 (pp. 299, 323-324) Zhang et al.	Project 1a – Monday, 9/13
9/16	RRD1 Synchronous Discussion and Land Use and Population The spatial information used to support urban planning and social, governmental, and related applications	RRD2 Bolstad, Ch. 3 (pp. 133-135) Leyk et al.	RRD 1 (synchronously, in class; asynchronously, before and after class session)
Week 5 9/21	Environmental Data and the NWM An introduction to key environmental data sets and their use in the National Water Model (NWM)	Bolstad, Ch. 7 (pp. 305-323)	
9/23	Finding Spatial Data Visit from Librarian Andy Rutkowski		
Module 3: Spatial Data Handling			
Week 6 9/28	Geodesy, Datums, and Geographic Coordinate Systems Role of geodesy and datums in studying and communicating our three-dimensional world	Project 2 Bolstad, Ch. 3 (pp. 87-115)	Project 1b – Monday, 9/27
9/30	Map Projections and Projected Coordinate Systems An introduction to the effects of project the three-dimensional world to a plane and benefits of doing so	Bolstad, Ch. 3 (pp. 116-133) & Ch. 4 (pp. 168-180)	
Week 7 10/5	RRD2 Synchronous Discussion and Attribute Tables and Spatial Databases The importance of attribute information associated with coordinates and options for storing spatial data	Bolstad, Ch. 8	RRD 2 (synchronously, in class; asynchronously, before and after class session)

Week	Topic	Assignments & Readings	Deliverables/Due Dates
10/7	Global Navigation Satellite Systems Introduction to geolocation systems and uses	Bolstad, Ch. 5	
Week 8* 10/12 *10/14-10/15 is a university holiday	Aerial and Satellite Imagery Introduction to passive and active remote sensing systems and the data they produce	Project 3 Bolstad, Ch. 6	Project 2 – Monday, 10/11
Week 9 10/19	Spatial Data Quality and Metadata Methods for assessing the quality and utility of spatial data and the importance of metadata	Bolstad, Ch. 4 (pp. 188-191) & Ch. 14 van Oort	Mid-Term Exam (asynchronous): Two-hour window of student's choosing from Mon. 10/18 9am PT – Tues. 10/19 9am PT
10/21	Volunteered and Crowdsourced Geographic Information Introduction to methods for collecting spatial data from non-professionals and the benefits and drawbacks of doing so	Bolstad, Ch. 7 (pp. 303-304) Senaratne et al. Verplanke et al.	
Module 4: Turning Spatial Data into Actionable Information			
Week 10 10/26	Terrain Analysis Map algebra and raster functions.	Project 4 Bolstad, Chs. 11, 13 (pp. 601-602) Bamutaze	Project 3 – Monday 10/25
10/28	Raster Analysis Land surface parameters and their uses.	Bolstad, Ch. 10	
Week 11 11/2	Introduction to Spatial Analysis Basic methods for using GIS to mathematically analyze spatial data	Bolstad, Ch. 9	
11/4	RRD3 Synchronous Discussion and Introduction to Spatial Modeling Introduction to the variety of models that are used to understand and predict spatial phenomena	RRD 4 Clarke et al.	RRD 3 (synchronously, in class; asynchronously, before and after class session)

Week	Topic	Assignments & Readings	Deliverables/Due Dates
Week 12 11/9	Spatial Estimation and Interpolation Introduction to spatial interpolation methods	Project 5 Bolstad, Ch. 12 (pp. 521-535)	
11/11	Cartography Best practices for creating finished mapping products	Bolstad, Ch. 4 (pp. 147-156) Skim: Kimerling, Chs. 6-8	
Week 13 11/16	RRD4 Synchronous Discussion and Modern Mapmaking Cartographic principles and methods for visualizing spatial data online	Project 5 Bolstad, Ch. 13 Kanevski	Project 4 – Monday, 11/15
Module 5: Future of GI Science, Systems, and Services			
11/18	Big Spatial Data An introduction to the variety of data created by widespread ownership and use of location-based services	Levy et al. Salathé, et al. Huang and Wang	RRD 4 (synchronously, in class; asynchronously, before and after class session)
Week 14* 11/23 *11/24-11/28 is a university holiday	Geospatial Intelligence Incorporation of location-based analytics, terrain, and other data to implement actionable intelligence in support of human security	RRD5 Marx	
Week 15 11/30	GIS Customization and Cloud Services Introduction to GIS in the cloud and to programming languages and platforms for modeling and automating spatial processes	Resume Assignment 2 Bolstad, Ch. 7 (p. 300) Steiniger & Hunter	
12/2	RRD5 Synchronous Discussion and Looking Forward for GIS The changing character and impact of GI science, systems, and services.	Bodenhamer Miller & Goodchild	RRD5 (synchronously, in class; asynchronously, before and after class session)
Study Days 12/4-12/7			Resume Assignment 2 – Monday, 12/6 Project 5 – Monday, 12/6
Finals Period 12/8-12/15	Asynchronous Final Exam – Day, Time TBD		

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” <https://policy.usc.edu/files/2020/07/SCampus-Part-B-1.pdf>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.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
suicidepreventionlifeline.org

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) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplcity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, 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.