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

SSCI 581 (Section 35892), Concepts for Spatial Thinking

Syllabus

Units: 4

Term — Day — Time: Fall 2017, Mondays and Wednesdays, 12 p.m. – 1:50 p.m. PT

Location: AHF 145D

Instructor: Katsuhiko "Kirk" Oda, PhD GISP
Office: AHF B56B
Regular Office Hours: Mon 11 am-12 pm PT and Wed 2-3 pm PT Also available most days and times by appointment via email.

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Course Scope and Purpose

This course is designed as an introduction to geographic information science, and more importantly, to the cartographic and spatial concepts underlying spatial thinking and the associated geospatial technologies.

In addition, the course, by both necessity and design, serves several different audiences given its role as a required entrée course for four online programs – the GIST M.S. and Graduate Certificate programs, the Geospatial Intelligence Graduate Certificate, and the GeoHealth track in the Keck School of Medicine's Master of Public Health program – and one residential program, the M.S. in Spatial Informatics. The different student clientele is provided with a variety of options in several of the major assignments so they can align the geospatial data, analysis, and visualization tasks tackled in these assignments with their own interests and aspirations.

Looking beyond these specific audiences, this is also a good course for those who simply wish to improve their GIS skills and for those who want to understand the underlying concepts. In this course, you will gain an understanding of the fundamentals of geographic information science, including geodesy, the evolving role of maps in science, policy and our everyday lives, and the ways in which various forms of spatial analysis, modeling and visualization can be performed using Esri's ArcGIS ecosystem.

Spatial thinking – 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 among working professionals, citizens and most of all, students of all ages. We will use a series of readings and case studies to show how spatial thinking permeates and supports various kinds of problem solving.

Geodesy – We will next turn our attention to geodesy, which is the branch of science concerned with the size and shape of the Earth and determining what is where on its surface. The major topics to be covered – geodetic datums, geoids, coordinate systems, and map projections – are fundamental building blocks for all that follows in our programs and of course, in the successful deployment and use of geospatial technologies.

Fundamentals of GIS – We will explore the evolving field of geographic information science and the relationships between this and other disciplines across the natural and social sciences, the humanities, engineering, and the applied sciences, and the professions (architecture, health, journalism, and social work, among others).

The ArcGIS Ecosystem – We will explore how the ArcGIS software ecosystem can be used to represent and analyze the world around us through a series of tutorials that cover different types of geospatial data, raster and vector data models, coordinate systems and map projections, and selected forms of geographic analysis, including geoprocessing and raster analysis.

Maps – Maps have been used for hundreds and possibly thousands of years to compile and communicate geographic concepts and relationships. Once the more or less exclusive domain of professional cartographers, maps can be authored and shared in new and wonderful ways

using 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 Discovery – Data is an essential component of GIS. We will explore core geospatial datasets and attain knowledge and skills necessary for processing and describing GIS data, including census data.

This is a graduate level course, so you should expect to be intellectually challenged throughout the term. As graduate students you must engage with the course contents and explore their heady cauldron of ideas, opinion, and analysis. Learning arises from active engagement with the knowledge found in our reading materials and with one another. As in any graduate class, the instructor's role is that of a guide to lead you on this path of discovery, and you will find that you learn much from your fellow classmates. The challenge for the instructor is to replicate such an academic experience within the milieu of learning in a digital era.

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through course notes and assigned readings. Written assignments will give students an opportunity to internalize 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. In addition, hands-on practical exercises will mainly use ArcGIS Pro.

Learning Outcomes

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

- Explain the role and importance of geodesy and how the various components – geodetic datums, geoids, coordinate systems, and map projections – can be used to position and locate things (i.e. places, people, features) on the Earth's surface.
- Specify how the various elements of spatial thinking can enable us to identify, describe, analyze, and visualize phenomena.
- Define the fundamental spatial concepts and terms such as arrangement, orientation, diffusion, dispersion, and pattern.
- Explain cartographic excellence and how maps and geographic understanding have been used throughout history to organize and empower different groups of people.
- Speculate on how maps might be used by various people in the next few decades.
- Describe one or more compelling applications of spatial thinking and why these kinds of workflows and/or solutions are important.

- Specify how the spatial analysis, modeling, and visualization tools included in geographic information systems and other geospatial technologies might be used to advance knowledge creation and communication across a variety of disciplines.
- Process, assess, and describe core geospatial datasets including census data.

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:

- Every student must have a computer with a fast Internet connection (DSL at a minimum).
- Every student must have 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 any type of 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 to be handed in will be submitted 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.

Please be sure that you read as soon as possible all email sent from Blackboard or from me. Do not ignore course email until the day before assignments are due. If you don't regularly use your USC email account, please double check to be sure that mail sent from both the USC Blackboard accounts and your instructor's account (noted above) is forwarded to an address you use regularly and does not go into your junk mail!

Required Readings and Supplementary Materials

Textbooks – There are seven texts for this course. We encourage you to purchase the first and the fourth of these books early since you will need these materials from the opening day of class. Please make sure to obtain the correct editions of the texts. 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. Please note that you are not required to buy the other textbooks. A portion of the second, third and fifth texts will be posted on Blackboard. The NRC Report can be downloaded free-of-charge from the web. The Wilson and Fotheringham book is available through the USC Libraries as an e-Book.

1. Bolstad, Paul. 2016. *GIS Fundamentals: A First Text on Geographic Information Systems* (5th Edition). Ann Arbor, MI: XanEdu Inc.
2. DeMers Michael. N. 2009. *Fundamentals of Geographic Information Systems* (4th edition). Hoboken, NJ: John Wiley & Sons, Inc.
3. Kimerling, A. Jon, Aileen R. Buckley, Phillip C. Muehrcke, and Juliana O. Muehrcke. 2016. *Map Use: Reading, Analysis, Interpretation* (8th edition). Redlands, CA: Esri Press.
4. Law, Michael, and Amy Collins. 2016. Getting to Know ArcGIS Pro (1st edition). Redlands, CA: Esri Press.
5. Mitchell, Andy. 2012. *The Esri Guide to GIS Analysis Volume 3: Modeling Suitability, Movement, and Interaction.* Redlands, CA: Esri Press.
6. National Research Council. 2006. *Learning to Think Spatially: GIS as a Support System in the K-12 Curriculum.* Washington, DC: National Academies Press (available at http://www.nap.edu/catalog.php?record_id=11019).
7. Wilson, John. P. and A. Stewart Fotheringham, (editors). 2008. *The Handbook of Geographic Information Science.* Oxford, Blackwell.

The aforementioned textbooks will be supplemented with Course Notes and a mixture of readings from academic journals, professional reports and authoritative websites.

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

1. Downs, Roger M. 1997. The geographic eye: Seeing through GIS? *Transactions in GIS* 2: 111-121.
2. Cebrecos, Alba, Julia Díez, Pedro Gullón, Usama Bilal, Manuel Franco, and Francisco Escobar. 2016. Characterizing physical activity and food urban environments: a GIS-based multicomponent proposal. *International Journal of Health Geographics* 15(1).
3. Goodchild, Michael F. 1992. Geographical information science. *International Journal of Geographical Information Systems* 1: 31-45.
4. Wright, Dawn J., Michael F. Goodchild and James D. Proctor. 1997. Demystifying the persistent ambiguity of GIS as "tool" versus "science." *Annals of the Association of American Geographers* 87(2): 346-362.
5. Reitsma, Femke. 2013. Revisiting the 'Is GIScience a science?' debate (or quite possibly scientific gerrymandering). *International Journal of Geographical Information Science* 2: 211-221.
6. Duckham, Matt. 2015. GI Expertise *Transactions in GIS* 19: 499-515.
7. DiBiase, David W., Michael DeMers, Ann Johnson, Karen Kemp, Ann T. Luck, Brandon Plewe, and Elizabeth Wentz. 2007. Introducing the first edition of Geographic Information Science and Technology Body of Knowledge. *Cartography and Geographic Information Science* 34: 113-118.
8. Kitchin, Rob and Martin Dodge. 2007. Rethinking maps. *Progress in Human Geography* 31: 331-334.

9. Batty, Michael, Andrew Hudson-Smith, Richard Milton, and Andrew Crooks 2010. Map mashups, Web 2 and the GIS revolution. *Annals of the Association of American Geographers* 16: 1-13.
10. Goodchild, Michael F. 2012. "GIScience in the 21st century." In *Advances in Geo-Spatial Information Science,* edited by Shi, W., Michael F. Goodchild, Brian Lees, and Yee Leung. Leiden, The Netherlands, CRC Press: 3-10.

Description and Assessment of Assignments

Weekly Assignments

There are several different kinds of assignments with at least one due weekly. These are described in the Weekly Folders on Blackboard. Due dates are shown in the summary that follows.

Resume Assignment – 1 worth 1 point. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Please prepare your resume in the SSI template which will be provided to you. Unless you opt out, your resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is compiled annually and, along with our web presence, is used to promote our programs, and more importantly, your skills, experience and professional aspirations.

Access SSI Server Tutorial – 1 worth 1 point. The SSI Server will be used frequently throughout the semester. Therefore, you must ensure the access to the server on the first week. To complete the exercise, you will refer to the Access SSI Server document.

Discussion Forums – 6 worth 12 points. Students are required to take part in online discussion forums via Blackboard. These will focus on varying combinations of theory and practice. You will post a minimum of six new messages (i.e. one per forum) and 12 replies to messages posted by your classmates (i.e. two per forum) at designated times throughout the semester.

Written Assignments – 5 worth 15 points. Each student is required to complete five written assignments for this class. These assignments will focus on the theory portion of the course as presented in weekly readings. The objective is to help you evaluate and integrate the information you have acquired from the course readings. Three of these assignments are required (for more detail, see the course schedule table at the end of this syllabus), and you are free to choose any two from the remaining assignments but you must complete and submit them for grading in the weeks specified in the Course Schedule below. If you complete more than five reading assignments, your instructor will use your highest two scores for the remaining assignments towards your course grade.

Geodesy Quiz – 1 worth 5 points. One quiz will be administered towards the end of the geodesy module and will afford each of you the opportunity to demonstrate your knowledge and understanding of geodetic datums, coordinate systems, and map projections.

ArcGIS Tutorials – 5 worth 15 points. You will work through Law and Collins' ArcGIS Pro workbook and selected Esri web courses. To demonstrate that you have completed each tutorial, you will turn in a written report for each. In addition, you will be expected to offer each other advice and assistance on tutorials through Blackboard.

Reading Quizzes – 20 worth 8 points. These assignments are short quizzes based on assigned readings. The questions draw on key topics and support student engagement with the readings.

GIS Data Tutorials – 3 worth 15 points. In this set of three tutorials, study sources of spatial data, collect data, and learn techniques for processing three types of spatial data. You will process U.S. Census data in the first tutorial and other GIS data types such as elevation, hydrography, land cover, and transportation networks in the following tutorials. You will describe properties of your obtained data such as the spatial and temporal granularity, measurement scales, sample designs, and possible applications.

Final Project

The Final Project is your opportunity to integrate all that you have learned in the semester by framing a geospatial question for decision support in a topic of your choosing. You will collect the appropriate spatial and non-spatial data, import the data into ArcGIS, produce and interpret a series of maps that represent geographic phenomena related to your spatial analysis. To help facilitate this work, the workflow is broken up into four distinct components:

Proposal - 6 points. A single paragraph (300-word maximum) that describes a research question and a table summarizing criteria for your spatial analysis.

Data Report - 3 points. A report documenting the data you have identified and acquired for your project. ALL data you plan to employ in your analysis should be included.

Final Report - 16 points. A final report of your project, which must not exceed 10-12 single-spaced and typed pages including figures, maps, tables and references.

Final Presentation - 3 points. You will deliver a presentation of your final project and attend the other students' presentations during our scheduled final exam.

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 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	6	2	12
Written Assignments	5	3	15
Geodesy Quiz	1	5	5
ArcGIS Tutorials	5	3	15
Reading Quiz	20	0.4	8
GIS Data Tutorials	3	5	15
Project Components			
Proposal	1	6	6
Data Report	1	3	3
Final Report	1	16	16
Final Presentation	1	3	3
Total	46	-	100

Assignment Submission Policy

Unless otherwise noted, assignments must be submitted via Blackboard by the due dates specified in the Course Schedule below and on the assignment instructions. Your 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 pm 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 and Assignments	Deliverables and Due Dates
Week 1	8/21	**Introduction**	Discussion Forum 1	Discussion Forum 1: Monday, 8/21

	8/23	**Introduction Cont.**	Course Syllabus NRC: Ch 1&2 Reading Quiz 1 Reading Quiz 2 Resume Assignment Access SSI Server Assignment	Reading Quiz 1: Wednesday, 8/23 Access SSI Server Assignment: Wednesday, 8/23
Week 2	8/28	**Spatial Thinking**	NRC: Ch 3 Downs 1997 Reading Quiz 3 Written Assignment 1 (Required) Discussion Forum 2	Resume Assignment: Monday, 8/28 Reading Quiz 2: Monday, 8/28 Reading Quiz 3: Monday, 8/28 Discussion Forum 2: Monday, 8/28
	8/30	**Introduction to ArcGIS**	Law: Ch 1&2 Reading Quiz 4 ArcGIS Tutorial 1	Written Assignment 1: Wednesday, 8/30
Week 3 9/6* *Monday, 9/4 is a university holiday		**Spatial Primitives**	DeMers: Ch 0&2 Law: Ch 3&10 Reading Quiz 5 Reading Quiz 6 Discussion Forum 3 ArcGIS Tutorial 2	ArcGIS Tutorial 1: Wednesday, 9/6 Reading Quiz 4: Wednesday, 9/6 Reading Quiz 5: Wednesday, 9/6 Discussion Forum 3: Wednesday, 9/6
Week 4	9/11	**Geodesy and Datums**	Bolstad: Ch 3 Reading Quiz 7	ArcGIS Tutorial 2: Monday, 9/11 Reading Quiz 6: Monday, 9/11 Reading Quiz 7: Monday, 9/11
	9/13	**Geoprocess-ing Tools**	Law: Ch 5&7 Reading Quiz 8 ArcGIS Tutorial 3	
Week 5	9/18	**Coordinate Systems**	Bolstad: Ch 3 Reading Quiz 9	ArcGIS Tutorial 3: Monday, 9/18 Reading Quiz 8: Monday, 9/18 Reading Quiz 9: Monday, 9/18

	9/20	**Tools for Raster Data**	Law: Ch 9 Reading Quiz 10 ArcGIS Tutorial 4	
Week 6	9/25	**Map Projections**	Bolstad: Ch 3 Cebrecos 2016 Geodesy Quiz Written Assignment 2 (Elective)	ArcGIS Tutorial 4: Monday, 9/25 Reading Quiz 10: Monday, 9/25 Geodesy Quiz: Monday, 9/25
	9/27	**Spatial Analysis for Decision Making**	ArcGIS Tutorial 5	
Week 7	10/2	**ArcGIS: Data Models**	Bolstad: Ch 2 Goodchild 1992 Written Assignment 3 (Elective) Reading Quiz 11	Written Assignment 2: Monday, 10/2 ArcGIS Tutorial 5: Monday, 10/2 Reading Quiz 11**:** Monday, 10/2
	10/4	**Final Project Proposal**	Final Project Proposal	Final Project Proposal: Wednesday, 10/4
Week 8	10/9	**ArcGIS: Vector Analysis**	Bolstad: Ch 9 Wright et al. 1997 Written Assignment 4 (Elective) Reading Quiz 12	Written Assignment 3: Monday, 10/9 Reading Quiz 12: Monday, 10/9
	10/11	**GIS Data 1: Census Data**	Reading Quiz 13 GIS Data Tutorial 1	
Week 9	10/16	**ArcGIS: Raster Analysis**	Bolstad: Ch 10 Reitsma 2013 Written Assignment 5 (Elective) Reading Quiz 14	Written Assignment 4: Monday, 10/16 GIS Data Tutorial 1: Monday, 10/16 Reading Quiz 13: Monday, 10/16 Reading Quiz 14: Monday, 10/16
	10/18	**GIS Data 2**	GIS Data Tutorial 2	

Week 10	10/23	**GIST Domains**	Duckham 2015 DiBiase et al. 2007 Written Assignment 6 (Required) Reading Quiz 15	GIS Data Tutorial 2: Monday, 10/23 Written Assignment 5: Monday, 10/23 Reading Quiz 15: Monday, 10/23
	10/25	**GIS Data 3**	GIS Data Tutorial 3	Written Assignment 6: Wednesday, 10/25
Week 11	10/30	**Geographic Information Systems**	Bolstad: Ch 1 Written Assignment 7 (Required) Reading Quiz 16	GIS Data Tutorial 3: Monday, 10/30 Written Assignment 7: Monday, 10/30 Reading Quiz 16: Monday, 10/30
	11/1	**Geographic Information Systems Cont.**	Discussion Forum 4	Discussion Forum 4: Wednesday, 11/1
Week 12	11/6	**Geographic Information Science**	Wilson & Fotheringham eds.: An Introduction Goodchild 1992 Wright et al. 1997 Reitsma 2013 Kitchin & Dodge 2007 Written Assignment 8 (Elective) Reading Quiz 17 Discussion Forum 5	Reading Quiz 17: Monday, 11/6 Discussion Forum 5: Monday, 11/6
	11/8	**Final Project Data Report**	Final Project Data Report	Final Project Data Report: Wednesday, 11/8
Week 13	11/13	**Maps and Spatial Analysis**	Bolstad: Ch 13 Mitchell: Ch 2 Batty et al. 2010 Written Assignment 9 (Elective) Reading Quiz 18	Written Assignment 8: Monday, 11/13 Reading Quiz 18: Monday, 11/13

	11/15	**Final Project GIS Modeling**	Final Project Final Report	
Week 14 11/20* *11/22-11/26 are university holidays		**Cartography and the History of Maps**	Kimerling et al.: Introduction Slocum et al.: Ch 2 Goodchild 2012 Written Assignment 10 (Elective) Reading Quiz 19	Written Assignment 9: Monday, 11/20 Reading Quiz 19: Monday, 11/20
Week 15	11/27	**Future Trends of Maps and GIS**	Bolstad: Ch 15 Wilson & Fotheringham eds.: Ch 33&34 Discussion Forum 6 Reading Quiz 20	Written Assignment 10: Monday, 11/27 Reading Quiz 20: Monday, 11/27 Discussion Forum 6: Monday, 11/27
	11/29	**Final Project Final Report**	Final Project Final Report	Final Project Final Report: No later than 05:00 pm PT on Wednesday, 11/29.
Final Exam			Final Project Presentation	Final Project Presentation: 11 am - 1 pm PT on Friday, 12/8 in AHF 145D

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 Section 11, *Behavior Violating University Standards* https://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.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Relationship and Sexual Violence Prevention Services* http://engemannshc.usc.edu/rsvp/ provides 24/7

confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Online Resources

The Course Blackboard page and the GIST Community Blackboard page have many resources available for students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link https://libraries.usc.edu/.