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

SSCI 581 (Section 35691), Concepts for Spatial Thinking

Syllabus

Units: 4

Term — Day — Time: Spring 2017, Online

Location: Online

Instructor: Katsuhiko "Kirk" Oda, PhD GISP
Office: AHF B56B
Regular Office Hours: Wed 9-10 am PT and Fri 12-1 pm PT
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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 professional 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 first 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 most concerned with positioning and determining what is where on Earth. The major topics to be covered – geodetic datums, geoids, coordinate systems, and map projections – are fundamental building blocks for all that follows in our online and residential courses and 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 or fields spread 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 also begin to explore how the ArcGIS software ecosystem can be used to represent the world around us using a series of tutorials that cover the various forms of geospatial data, the 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 Web. We will review past, present and future uses of maps and how these can be generated and used to 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 this class to be intellectually challenging. As graduate students you are expected to engage with the information you are learning and to explore the heady cauldron of ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. 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 who keeps you on this path of discovery and you will find that you will 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. Some assignments require student interaction. 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:

- A computer with a fast Internet connection.
- An up-to-date web browser to access the SSI Server

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) me on the email.

Communications – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard. 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.

I will send via email through Blackboard any notices that are time sensitive. 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. Also double check to be sure that email sent from the USC blackboard account does not go into your junk mail!

While I am often on-line and will respond to emails from students very quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72 hours delay. In the rare case when I expect to be off-line for more than 72 hours, I will post an announcement on the Blackboard site.

Discussion and collaborative work – In the classroom, you will discuss your learnt concepts and theory with your classmates and work with them to complete course assignments, exercises, and projects as the need arises. Through discussion and collaborative work, students can provide support to each other while working on your assignments, sharing hints and helpful tips.

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 the NRC Report can be downloaded free-of-charge from the web and that a portion of the second, third and fourth texts will be posted on Blackboard, and 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. 2012. *Map Use: Reading and Analysis* (7th 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 2 points. 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. These will focus on varying combinations of theory and practice and anticipate that 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 at the end of this syllabus. If you complete more than five reading assignments, I will use your highest two scores for the remaining assignments to calculate 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 Esri web courses. To demonstrate that you have completed each tutorial, you

will turn in brief text answers and/or a copy of some digital output from the exercise such as a map. In addition, you will be expected to offer each other advice and assistance on tutorials through Blackboard.

Reading Self Check Assignments – 20 worth 8 points. These assignments are reading assignments which typically consist of four questions. The questions serve as a guide to you in your reading and as a basis for class discussion and ArcGIS Tutorials. The goal of the Reading Self Check assignments is to have informed class activity, and to use class time to focus on applying, analyzing, and evaluating the material with the aid of fellow students and with your instructor's guidance. You are required to submit your answers before you come to the classroom.

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

Final Project

The Final Project will be your opportunity to integrate all that you have learned in the semester by framing a geospatial question for decision support. In the project 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, and indicate how you would proceed if you were to complete the analysis and what you anticipate would be the final results. To help facilitate this work, the final project is designed to explicitly include options for a wide range of different student clientele and is broken up into four distinct components with their own points as follows:

Proposal - 4 points. A single paragraph (300-word maximum) that describes a research question and a table summarizing criteria for your spatial analysis in decision support systems.

Data Report - 6 points. A report documenting the data you have identified and acquired for your project.

Final Report - 12 points. The final report itself which must not exceed 10-12 single-spaced and typed pages plus figures, maps, tables and references.

Final Presentation - 5 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	2	2
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 Self Check Assignments	20	0.4	8
GIS Data Tutorials	3	5	15
Project Components			
Proposal	1	4	4
Data Report	1	6	6
Final Report	1	12	12
Final Presentation	1	5	5
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 if I am to meet my goal to return comments on your submitted assignments before the next one is due. Sometimes this is impossible, so I will post a notice on anticipated delays if needed.

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.

Schedule

	Topic	Readings and Assignments	Deliverables and Due Dates
Week 1 1/9	**Introduction**	Course Syllabus NRC: Ch 1&2 Resume Assignment Access SSI Server Assignment Discussion Forum 1 Reading Self Check Assignment 1 Reading Self Check Assignment 2	No deliverables
Week 2 1/17* *Monday, 1/16 is a university holiday	**Spatial Thinking**	NRC: Ch 3 Downs 1997 Law: Ch 1&2 Written Assignment 1 (Required) ArcGIS Tutorial 1 Discussion Forum 2 Reading Self Check Assignment 3 Reading Self Check Assignment 4	Resume Assignment: Tuesday, 1/17 Access SSI Server Assignment: Tuesday, 1/17 Discussion Forum 1: Tuesday, 1/17 Reading Self Check Assignment 1: Tuesday, 1/17 Reading Self Check Assignment 2: Tuesday, 1/17
Week 3 1/23	**Spatial Primitives**	DeMers: Ch 0&2 Law: Ch 3&10 ArcGIS Tutorial 2 Discussion Forum 3 Reading Self Check Assignment 5 Reading Self Check Assignment 6	Written Assignment 1: Tuesday, 1/24 ArcGIS Tutorial 1: Tuesday, 1/24 Discussion Forum 2: Tuesday, 1/24 Reading Self Check Assignment 3: Tuesday, 1/24 Reading Self Check Assignment 4: Tuesday, 1/24
Week 4 1/30	**Geodesy and Datums**	Bolstad: Ch 3 Law: Ch 5&7 ArcGIS Tutorial 3 Reading Self Check Assignment 7 Reading Self Check Assignment 8	ArcGIS Tutorial 2: Tuesday, 1/31 Discussion Forum 3: Tuesday, 1/31 Reading Self Check Assignment 5: Tuesday, 1/31 Reading Self Check Assignment 6: Tuesday, 1/31

Week 5 2/6	**Coordinate Systems**	Bolstad: Ch 3 Law: Ch 9 ArcGIS Tutorial 4 Reading Self Check Assignment 9 Reading Self Check Assignment 10	ArcGIS Tutorial 3: Tuesday, 2/7 Reading Self Check Assignment 7: Tuesday, 2/7 Reading Self Check Assignment 8: Tuesday, 2/7
Week 6 2/13	**Map Projections**	Bolstad: Ch 3 Cebrecos 2016 Geodesy Quiz Written Assignment 2 (Elective) ArcGIS Tutorial 5 Reading Self Check Assignment 11	ArcGIS Tutorial 4: Tuesday, 2/14 Reading Self Check Assignment 9: Tuesday, 2/14 Reading Self Check Assignment 10: Tuesday, 2/14
Week 7 2/21* *Monday, 2/20 is university holiday	**ArcGIS: Data Models**	Bolstad: Ch 2 Goodchild 1992 Written Assignment 3 (Elective) Final Project Proposal Reading Self Check Assignment 12	Geodesy Quiz: Tuesday, 2/21 Written Assignment 2: Tuesday, 2/21 ArcGIS Tutorial 5: Tuesday, 2/21 Reading Self Check Assignment 11: Tuesday, 2/21
Week 8 2/27	**ArcGIS: Vector Analysis**	Bolstad: Ch 9 Wright et al. 1997 Written Assignment 4 (Elective) GIS Data Tutorial 1 Reading Self Check Assignment 13	Written Assignment 3: Tuesday, 2/28 Final Project Proposal: Tuesday, 2/28 Reading Self Check Assignment 12**:** Tuesday, 2/28
Week 9 3/6 Each student has a meeting for the Final Project.	**ArcGIS: Raster Analysis**	Bolstad: Ch 10 Reitsma 2013 Written Assignment 5 (Elective) GIS Data Tutorial 2 Reading Self Check Assignment 14	Written Assignment 4: Tuesday, 3/7 GIS Data Tutorial 1: Tuesday, 3/7 Reading Self Check Assignment 13: Tuesday, 3/7
3/13* *3/13-3/17 is Spring Recess			

Week 10 3/20	**GIST Domains**	Duckham 2015 DiBiase et al. 2007 Written Assignment 6 (Required) GIS Data Tutorial 3 Reading Self Check Assignment 15	Written Assignment 5: Tuesday, 3/21 GIS Data Tutorial 2: Tuesday, 3/21 Reading Self Check Assignment 14: Tuesday, 3/21
Week 11 3/27	**Geographic Information Systems**	Bolstad: Ch 1 Discussion Forum 4 Written Assignment 7 (Required) Reading Self Check Assignment 16	Written Assignment 6: Tuesday, 3/28 GIS Data Tutorial 3: Tuesday, 3/28 Reading Self Check Assignment 15: Tuesday, 3/28
Week 12 4/3	**Geographic Information Science**	Wilson & Fotheringham eds.: An Introduction Goodchild 1992 Wright et al. 1997 Reitsma 2013 Kitchin & Dodge 2007 Discussion Forum 5 Written Assignment 8 (Elective) Final Project Data Report Reading Self Check Assignment 17	Discussion Forum 4: Tuesday, 3/7 Written Assignment 7: Tuesday, 4/4 Reading Self Check Assignment 16: Tuesday, 4/4
Week 13 4/10	**Maps and Spatial Analysis**	Bolstad: Ch 13 Mitchell: Ch 2 Batty et al. 2010 Written Assignment 9 (Elective) Reading Self Check Assignment 18	Discussion Forum 5: Tuesday, 3/21 Written Assignment 8: Tuesday, 4/11 Final Project Data Report: Tuesday, 4/11 Reading Self Check Assignment 17: Tuesday, 4/11
Week 14 4/17	**Cartography and the History of Maps**	Kimerling et al.: Introduction Slocum et al.: Ch 2 Goodchild 2012 Written Assignment 10 (Elective) Reading Self Check Assignment 19 Final Project Final Report	Written Assignment 9: Tuesday, 4/18 Reading Self Check Assignment 18: Tuesday, 4/18

Week 15 4/24 *Friday, 4/28 is the last day of class	**Future Trends of Maps and GIS**	Bolstad: Ch 15 Wilson & Fotheringham eds.: Ch 33&34 Discussion Forum 6 Reading Self Check Assignment 20 Final Project Final Report	Written Assignment 10: Tuesday, 4/25 Reading Self Check Assignment 19: Tuesday, 4/25 Discussion Forum 6: No later than 05:00 pm PT on Friday, 4/28 Reading Self Check Assignment 20: No later than 05:00 pm PT on Friday, 4/28 Final Project Final Report: No later than 05:00 pm PT on Friday, 4/28.
Final Exam		Final Project Presentation	Final Project Presentation: Date and time for presentation slots will be scheduled.

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/student/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/.