GEOG 581
Concepts For Spatial Thinking

University of Southern California

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Many of the various challenges that confront us at the dawn of the 21st century appear particularly daunting not so much because they are fraught with the unknown or the unexpected but because they are so complex. Ironically, it is not that world has become that more complex; it is just that we now have the technology to capture store, manipulate and communicate so much more information about our world. We need to find new ways of assembling this data so we can comprehend it. And we find ourselves turning to an old familiar tool, the map. But this is not your daddy's road map. This is Geographic Information Science (GIS). Here the technology has transformed a simple guide into a powerful analytic vehicle. (Well, maps have never been entirely that simple). As with any truly useful new technology, GIS applications are swiftly permeating all levels of public and private decision-making. There are just not enough trained GIS professionals to meet this growing demand.

This course is designed as an introduction to GIS, and more importantly, to the cartographic and spatial concepts underlying GIS. You will gain an understanding of the basic concepts of cartography, working with spatial information, GIS, and ArcGIS software.

Organization

"Concepts for Spatial Thinking" is the entrée course for both the GIST Certificate and for the new GIST Master of Science degree program. This is also a good course for those who are considering getting more seriously involved with GIS and want to first understand the underlying concepts. This course is organized into three modules:

*The Nature of Maps – We start by focusing on basic concepts that are fundamental to understanding the nature of geographic knowledge, how this knowledge is communicated, and how it can be graphically depicted.

*Spatial Thinking – In this section we examine some basic notions of cognition, mental representations of space, meaning in maps, spatial thinking and spatial problems.

*Fundamentals of GIS – This section actually entails most of the course. Here we examine the nature of computer systems and that of geographically referenced data. We will be providing you a structured introduction to ArcGIS 9.3, the most recent version of the most widely used GIS software. At the same time we shall consider various aspects of spatial analysis, data input and verification, data analysis and modeling. We will also review the history and development of GIS, the costs and disadvantages of GIS and likely future developments in GIS.

Teaching and Learning Strategies

This particular course presents some unique challenges for me as an educator and for you as students. These challenges arise from the technical nature of GIS, the fact that this course is a graduate course, and that Geography 581 is a distance learning course.

Basically, GIS is just software and data, just computer code. We will be providing you with our own instructional tutorial on ArcGIS. However, the power, indeed magic, of GIS is what you do with it. So this course is not just about learning GIS software. It is about teaching you to understand certain spatial and cartographic concepts so you can master that potential power. Yet, because of the technical character of GIS, there exists a tendency to focus on the software and data.

This a graduate level course, so you should expect this class to be both academically robust and intellectually challenging. A good graduate learning setting occurs within 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. My role as instructor should be that of a guide that keeps you on this path of discovery. The challenge for us is how we can replicate such an academic experience within the milieu of "distance learning".

Perhaps, some of you may already have had experience with an online course. Inevitably, such courses seem to involve programmed readings and exercises, but not much interaction directly with the instructor and certainly none with fellow students. In the realm of computerized learning it is not really surprising that the default is to the solitary gamer. To counter this tendency I am deliberately incorporating specific methodologies to encourage and facilitate our interaction. These include:

Individual meetings: Over the next few weeks, I want to meet with each of you individually. I expect this meeting should not take more than about 20 minutes. For those on campus or nearby, contact me at jswift@usc.edu to schedule a convenient time. My office presently is in Kaprielian Hall, Room KAP 450B. Tuesday, Wednesday and Thursday mornings work best for me, but I can arrange a meeting at another time or after hours. For those off campus or at some distance, we will have our meeting online. For this you will need to acquire a video cam and headset. If you do not already have one, then we recommend *Microsoft LifeCam VX-3000*. I will be using *Adobe Connect* for individual and group meetings; I will send you instructions for using this tool right before the 1st meeting, but generally there is no need for you to install anything as it is already supported by most browsers. We can also use *Skype* for individual meetings. After you get your video camera and microphone working, to test them you can access Skype (it's free); you can download the program at http://www.skype.com/download/. Once you've installed it, search for me: Contacts > Search for Skype Users... enter my username is **ssb27q**, Los Angeles. Only one entry should come up. Add me as one of your contacts, then e-mail me to schedule a time for our 1st individual online videocam meeting.

Video conferencing: I plan to schedule three class meetings over the semester. Attendance at least two of these meeting will be mandatory. In order for those off campus and at distant locations to be able to fully participate, we will set these up as videoconferences. I will be polling you as to what the best timing should be, but be aware that we might be constrained by the availability of facilities.

Team assignments: There may be at least one project in which you will be paired with another classmate.

Shared work: There will be some coursework that you will be doing also for the benefit your classmates. Specifically, each of you will be assigned one or more of the readings to summarize and distribute to the rest of the class.

Critiques: For certain assignments you will be tasked to analyze and critically review one another's work.

Introductions: In the Course Outline below, you'll see we begin with "Introduction to 586". To get a start on getting to know one another, I want you to prepare a biographical sketch of about 100 words. By the end of the first week, you should post your bio and a recent photo on Blackboard; under the button 'Student Bios > Student Homepages, click the button 'Create Blog Entry'; enter your name as the title, add a message and attach a photo or other file, and click 'Post Entry'. You will be able to view each other's Bios in this content area on our Blackboard.

Learning Outcomes

On completion of GEOG 581, students will be able to do the following:

* Understand and assess the different components of Geographic Information Science, and the various linkages of Geographic Information Science to other scientific disciplines;
* Analyze, in detail, how geospatial data models are utilized in the representation of geographical phenomena, and be able to evaluate the appropriateness of such models for specific applications;
* Explain the purpose, techniques and algorithms of spatial operations used in GIS, and evaluate the constraints placed on their use by specific data types and models; and
* Make efficient use of GIS software and be capable of implementing appropriate analytical procedures for any given application.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to an instructor as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://web-app.usc.edu/scampus/wp-content/uploads/2009/08/appendix_a.pdf . Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

Grading

Your grade in this class will be determined on the basis of several mapping exercises, a brief paper, a semester project in GIS, completion of the Computer Assignments, your participation in various other assignments, and your contributions to the class. Grades will be weighted according to the following schedule:

Maps and Critiques	(20%)
Semester GIS Project – Proposal & draft	(10%)
Semester GIS Project -- Final	(20%)
GIST Instructional Tutorials	(28%)
Other Assignments/participation	(22%)

Course Outline

This course is intended to be self-paced. Still, there are time limitations to which we must attend. It is important that you maintain momentum in completing the course work. What follows is a course outline depicting the topics we will be covering with approximates dates. There will of course be specified deadlines for the work that you turn in. Our semester ends officially on December 16, 2009.

Introductions week 1

Section 1: Introduction weeks 2, 3
1.1 A Voyage of Discovery
1.2 Geography in Decision Making
1.3 Maps as Communication Systems

Tutorial 1: Introduction to ArcGIS

Section 2: Spatial Thinking weeks 4, 5
2.1 Cognition of Space
2.2 Mapping Language and Meaning
2.3 Cognition and the Use of Maps
2.4 Mental Representation
2.5 Learning Spatial Information
2.6 Spatial Thinking and Spatial Problems
2.7 Skills in Spatial Thinking

Tutorial 2: GIS Data Models

Section 3: What is GIS? weeks 6, 7
3.1 Defining GIS
3.2 Fundamentals of Computer Systems
3.3 Geographically Referenced Data
3.4 Spatial Entities or Features
3.5 Spatial Referencing
3.6 Management and Analysis Procedures
3.7 What GIS Is Not

Tutorial 3: ArcGIS Project and Data Management

Section 4: What Does GIS Do? weeks 8, 9
4.1 Introduction
4.2 Data Input and Verification
4.3 Data Storage and Database Management
4.4 Data Analysis and Modeling
4.5 Data Display and Output

Tutorial 4: Simple Spatial Analyses

Section 5: Why Use GIS? weeks 10, 11
5.1 Using Maps Without GIS
5.2 The Benefits of GIS
5.3 Costs and Disadvantages of Adopting GIS

Section 6: The Development of GIS weeks 12
6.1 Introduction
6.2 Computer Cartography
6.3 Spatial Analysis
6.4 GIS and the Convergence of Cartography and Spatial Analysis
6.5 The 1980s, 1990s, and 2000s
6.6 The Future for GIS

Final Project (Due end of Semester) *August 9, 2010*

Readings

The course readings are listed below. These will be made available to you via Blackboard. Any schedule of readings is a "work-in-progress". Additional materials appropriate to the specific topics will be identified as the course progresses, and I will consider any contributions you may suggest.

1. Gewin, Virginia (2004), "Mapping Opportunities" *Nature,* 47: p. 376-377

2. Darling, Juanita (2000), "Turn Left at the Big Lake and Meet Me in Managua*" Los Angeles Times*, August 1, 2000, p. A6

3. Blumrich, J.F. (1970), "Design". *Science*, 168: p. 1551-1554

4. Muehrcke P.C. and Muehrcke, J.O. (1992), Map Use: Reading, Analysis, and Interpretation. Introduction, p. 1 - 19

5. Abler, R.F. (1993), "Everything in it s Place: GPS, GIS, and Geography in the 1990s." *The Professional Geographer*, 45: 131-9

6. Goodchild, Michael (2000), "Communicating Geographic Information in a Digital Age"*, Annals of the Association of American Geographers*, (vol. 90, No. 2), pg 344-355

7. Vice President Al Gore, "The Digital Earth: Understanding Our Planet in the 21st Century" (speech presented January 31, 1999, Los Angeles)

8. Robinson A. and Petchnik, B. (1976), Mapping, Language and Meaning, The Nature of Maps, Chap 3

9. Green, R.T. and Courtis, M.C. (1966), "Information Theory and Figure Perception: the Metaphor that Failed". *Acta Psychologica*, 25, 12-36

10. Downs, R.M. (1994), "Being and Becoming a Geographer: An Agenda for Geography Education." *Annals of the Association of American Geographers*, 84: 175-91

11. Platt, J.R. (1964), "Strong Inference", *Science*, 146, 347-352

12. Gilbert, G.K. (1896), "The Origin of Hypotheses Illustrated by the Discussion of a Topographic Problem". *Science,* 168, 1551-1554

13. Chakraborty, J, Schweitzer, L and Forkenbrock, D (1999) "Using GIS to Assess the Environmental Justice Consequences of Transportation System Changes." *Transactions in GIS* 3(3): 239-258

14. Downs R M (1997), "The Geographic Eye: Seeing Through GIS?" *Transactions in GIS*, 2: 111-122

15. Shepard IDH (1991), "Information Integration and GIS." in Maguire DJ et al (eds), Geographical Information Systems: Principles and Applications. John Wiley and Sons, New York: 337-360

16. Openshaw S (1991) "Developing Appropriate Spatial Analysis Methods for GIS." in Maguire DJ et al (eds), Geographical Information Systems: Principles and Applications. John Wiley and Sons, New York: 389-402

17. Buttenfield B P and Mackaness W A (1991) "Visualization," in Maguire DJ et al (eds), Geographical Information Systems: Principles and Applications. John Wiley Sons, New York: 427-443

18. Moreno-Sánchez R, Malczewski J, Bojorquez-Tapia L A (1997) "Design And Development Strategy For Multimedia GIS To Support Environmental Negotiation, Administration, And Monitoring At The Regional Level." *Transactions in GIS*, 1: 161-76

19. Burrough P A, Craglia M, Masser I, Rhind D W (1997) "Decision makers' perspectives on European geographic information policy issues". *Transactions in GIS*, 2: 61-72

20. Gillespie SR (2000) "An empirical approach to estimating GIS benefits". *URISA Journal* 12(1): 7-14

21. Coppock T J, Rhind D W (1991) "The history of GIS". In Maguire D J, Goodchild M F, Rhind D W (eds) Geographical Information Systems: Principles and Applications. Longman, New York, 2 Volumes: 21-43

22. Rhind D W (1996) "Economic, Legal, And Public Policy Issues Influencing The Creation, Accessibility, And Use Of GIS Databases". *Transactions in GIS,* 1: 3-12

23. Drummond WJ, French SP (2008) "The Future of GIS in Planning: Converging Technologies and Diverging Interests." *Journal of the American Planning Association*, 74(2): 161-175

24. Goodchild MF and Longley PA (1999) "The Future of GIS and Spatial Analysis," in PA Longley, M F Goodchild, D J Maguire, and D W Rhind (eds), Geographical Information Systems: Principles, Techniques, Management and Applications. John Wiley, New York, Volume 1: 567-580