Proposal: Bachelor of Science in Geographic Information Science

I. GENERAL INFORMATION

1. Give the name of the proposed major.
Geographic Information Science

2. State what degree students competing the major will receive.
Bachelor of Science in Geographic Information Science

3. State the proposed implementation date.
Autumn 2009

4. Identify the academic units (e.g. department, college, etc.) responsible for administrating the major program.
Department of Geography, College of Social and Behavioral Sciences, Colleges of the Arts and Sciences

II. RATIONALE

5. Describe the rational/purpose of the major.

Maps have long served as a means for presenting location-based information. However, since the advent of computerized geographic information systems (GIS) in the 1960s, as well as the subsequent development of software and computing power, maps have become a much more widespread means for managing, analyzing, and communicating geospatial information.

The extensive demand for GIS skills has entailed a significant role for Geography. Indeed, although GIS is a multi-disciplinary endeavor, geographers have produced the bulk of what now comprise the core knowledge areas of the field. The Geography department at Ohio State in particular has been at the forefront of developments in GIS over the past 40 years. The department is ranked in the top 5 departments nationally, and is recognized globally as a leader in cartographic, spatial analytic and GIS-related teaching and research.

There are currently two GIS-related specializations offered in the department: Analytical Cartography and Geographic Information Systems (See Appendix B). These specializations reflect a division of labor between faculty in the department dating back several decades. Due to a significant turnover in faculty appointments over the past decade, as well as to changing pedagogical norms, we currently offer only the GIS specialization. The GIS specialization is popular among students: we enroll on average about 40 students per year, representing approximately 20% of our departmental majors.

Our department's commitment to revising the GIS curriculum dates to the late 1990s. In 1998, Professor Duane Marble (now emeritus), was appointed chair of the national Model Curricula Task Force commissioned by the University Consortium for Geographic Information Science (UCGIS). The UCGIS task force was convened in order to address worries by GIS departments across the country that undergraduate curricula in GIS were dated, and that as a result

students were inadequately prepared for the demands of the workplace. The task force deliberations were recently published as the *Geographic Information Science and Technology Body of Knowledge 2006* (DiBiase et al., 2006). The report reflects the insights of more than 70 educators, researchers, and practitioners. Its goals are to a) foster greater coherence and effectiveness within the GIS education community, and b) to outline what core knowledge, skills, and applications areas should be covered in a rigorous geographic information science education (see Appendix A).

During the 2007-2008 academic year, GIS-related faculty in the department undertook an extensive and collaborative review of course content based on the external standards of excellence suggested in the 2006 report. We also solicited detailed feedback from current geography majors specializing in GIS. Our goal was to identify significant overlaps and/or shortcomings in our curriculum. Our review indicated that while we cover a significant amount of the material suggested in the 2006 UCGIS document, our curriculum could do more to cover some fundamental knowledge areas. Faculty and students also agreed that while students are generally well-prepared for post-graduation employment, more could be done to enhance our graduates' readiness for the job market, including ensuring enough depth and breadth of coursework in the core areas of GIScience and emphasizing application oriented training.

Based on the importance of geotechnologies in society, the strength of the Department of Geography at OSU, the existence of the Body of Knowledge 2006 document, and the recent review by the department, the department is proposing a new major in Geographic Information Sciences (Appendix C). There are three main rationales for proposing a new major:

1. The new major will allow students to gain unprecedented breadth and depth in GIS. Students in the proposed major will receive comprehensive and progressive training from the top scholars in the field. Students not only learn to use software, but also the underlying theories for data structures, geographic analysis, as well as its application to a variety of real world issues. The comprehensive nature of this training not only exceeds that offered by GIS certification programs (which mainly focus on learning software), but also that offered in the current GIS specialization in the OSU Department of Geography.
2. The new major will benefit not only from the expertise of current faculty, but from the long history of research, teaching, and application of GIS in the OSU Department of Geography. Students in this major will profit from the depth of experience this department has in research and teaching on geotechnologies.
3. The major will increase the visibility of GIS at the Ohio State University and in the State of Ohio. Although geospatial technology is among the most important emerging fields today (Gewin 2004), it is not as visible as it should be. This seems to be because GIS is embedded in the discipline of geography, which is unfamiliar to most undergraduates in the United States. Having a stand-alone major will help overcome this problem; at the same time, having that major associated with a top-ranked geography department will ensure that the major continue to benefit from its disciplinary home.

6. Identify any unique characteristics or resources that make it particularly appropriate for Ohio State to offer the proposed major.

A. Department resources.

The proposed major will continue to be housed in Geography, where it will benefit from the department's world-class faculty and depth of experience in GIS education. The major also benefits because the courses and facilities are not only in place, but already well-tested.

Faculty: The department of Geography has seven full-time tenure track faculty in the area of GIS and related sciences (out of a full faculty of 25) (see Appendix F and Appendix G). These leaders in the field are internationally known for their innovative research. Many have ongoing collaborations and formal affiliations with other departments and colleges on campus, which will broaden the resources available to students in the proposed major.

Teaching resources: The department already offers almost all courses that are required in the proposed major. Included among these is an interdisciplinary course in the Fundamentals of GIS (Geog 607) that is co-taught by faculty in Geography, Civil Engineering, City and Regional Planning, and Geodetic Science.

Computer facilities: The department has extensive computer labs with necessary software and instrumentation for teaching and research in the many aspects of GIScience. See Section 30 for a full description.

Student space and facilities: The department also has an active Geography Club, in which GIS majors will be encouraged to participate; this Club will soon have its own academic resource center with computer facilities, academic journals, and publications of current faculty.

Advising staff: The department maintains its own undergraduate advising program, that will also serve the students in the GIS major. Rick McClish is the fulltime undergraduate advisor, and Assoc. Prof. Becky Mansfield serves as the honors advisor.

Relations with local government and business: Through ongoing research projects, alumni, and an active internship program, geography has existing linkages with a variety of state and local government agencies (e.g. Ohio EPA) and local businesses (e.g. Nationwide Insurance). These linkages are especially valuable for students seeking internship positions. Current Geography students with a GIS specialization have obtained valuable experience through such internships, many of which are paid positions.

B. University resources.

Centers for research and outreach: The university has a variety of centers for interdisciplinary research and outreach that help inform and enhance course content, provide points of contact for students, and provide potential for other forms of interaction beyond the university (e.g. internships, hourly positions, undergraduate research). Primary among these is the Center for Mapping, whose mission focuses on GIS and related technologies. Others include the Center for Human Resource Research, the Criminal Justice Research Center, the Center for Urban and Regional Analysis, John Glenn Institute for Public Service and Public Policy, the Kirwan Institute for Race and Ethnicity, and the Initiative on Population Research.

Library resources: Another important university resource unique to Ohio State is the Libraries Map Room collection, which includes a wide array of map collections of regional and global significance. The libraries has a dedicated librarian for Maps, Steve Rogers, who has many years of experience with the collection and with helping undergraduate students.

7. Cite the benefits for students, the institution, and the region or state.

The primary benefit for students is that the proposed new major is tailored specifically to fit the needs of students who want to pursue careers or higher education in geospatial technologies. Students will develop a substantive knowledge base that answers to specific job market demands in a growing industry. It also clearly identifies the students' major as Geographic Information Sciences, which is a degree that is clearly recognized by potential employers. A bachelor's degree in GIS is today the preferred entry level degree for a beginning career as a GIS professional (see item 10 below). The proposed major is organized to provide the foundation and skills necessary with a clear path to graduation. It also includes sufficient flexibility that the professional undergraduate advisor in Geography can help students choose the courses to satisfy the requirements of the General Education Curriculum (GEC) and their electives to match their specific goals. Students who complete the proposed major will be well positioned to take the next step after they graduate.

The principal benefit to the university is that the proposed new major will attract some high quality students that would otherwise attend other universities. Having a prominent GIS major will attract driven and goal-oriented students from across Ohio, and beyond. In addition to adding to the intellectual vitality of the university, some of the best students may also choose to continue at Ohio State and do their graduate work in the Geography department. Another benefit of the proposed major to the University is that it will provide the opportunity for students in other majors to double-major or minor in GIS. This will provide these students with both substantive knowledge and technical skills that will enhance their position in the job market. A GIS major will also make an important contribution to the University's outreach mission by means of the many application and service learning-oriented courses in the curriculum. Several courses require students to engage directly with clients, both within and outside of the university, in various forms of projects ranging from spatial database development, to integrated spatial analyses, to map design.

The principal benefit to the state of Ohio is that the proposed new major would keep more bright motivated undergraduate students in the state, as there are currently few universities in Ohio that currently offer an undergraduate major in GIS. The proposed new major would also provide a source of potential employees for the wide range of businesses that require people who can manipulate, analyze, and visualize spatial data. Major employers such as Nationwide Insurance, American Electric Power, city and regional governments all need employees with expertise in designing and using GIS.

8. List similar majors offered in both public and private institutions in Ohio and the U.S. Explain how these majors compare to the one proposed.

Valid data on GIS oriented degrees are difficult to obtain since the field does not have an unambiguous Classification by Instructional Program (CIP) code in the U.S. Department of Education data bases. It is clear, however, that very few higher education institutions offer baccalaureate degree programs in GIS. Many offer specializations in GIS *as part of* a degree in geography, which is the current situation here at Ohio State. While these provide intermediate and advanced training in GIS, they do not offer the comprehensive and progressive training of the proposed BS in GIS.

Within Ohio, only one other university (Ohio University) offers a four-year major in GIS. As with the current proposal, this major is housed in a Geography department. However, unlike our proposed major, students at Ohio University complete the requirements for a general Geography major rather than focusing extensively on GIS related knowledge and skills. Six universities and colleges offer a GIS certificate program and/or a 2-year degree, one offers only a GIS minor, and three (other than OSU) offer GIS as a specialization within the Geography major.

GIS Education in Ohio

Bowling Green State University	Bowling Green, OH	Geography & Geology major
Cleveland State University	Cleveland, OH	Graduate and undergraduate GIS certificate programs
Columbus State Community College	Columbus, OH	GIS Certificate and 2-yr degree programs
Hocking College	Nelsonville, OH	GI/GPS Certificate and 2-year degree program
James A. Rhodes State College	Lima, OH	GIS Certificate and 2-year degree program
Kent State University	Kent, OH	Geography major
Miami University	Oxford, OH	GIS Certificate
Ohio Northern University	Ada, OH	GIS minor
Ohio State University	Columbus, OH	Geography major
Ohio University	Athens, OH	GIS Analyst major
Ohio Wesleyan University	Delaware, OH	Geography major
University of Cincinnati	Cincinnati, OH	BS Geography
University of Akron	Akron, OH	BS Geography and Certificate in GISci

9. Cite enrollment patterns of similar majors in Ohio or in the United States.

We conducted a survey of GIS programs at four-year institutions in Ohio, and other university of similar size, including peer Big 10 institutions. Of these contacts, we received a few responses.

Departments with GIS majors: Ohio University currently has 18 students enrolled in the GIS major, with yearly enrollments averaging between 15-20 students since inception of the program seven years ago. Michigan State University has had on average 12 students since the major's inception in 2005. (Their specialization averages 20 students per year).

Departments with GIS specializations within the Geography major: University of Cincinnati has a modest number of students in the GIS specialization of the Geography major (3-4 students per year). University of Minnesota has a specialization in GIS, with about 27 students per year. The department just began a minor in GIS, to begin Fall 2008.

10. Describe career opportunities and/or opportunities for graduate or professional study available to persons who complete the major.

Students graduating from OSU with a major in GIS will be well positioned to find gainful employment. In 2004 the U.S. Department of Labor identified geotechnology as one of the three most important emerging and evolving fields, along with nanotechnology and biotechnology. Traditionally, the public sector has been the main employer of GIS professionals. There are also growing opportunities within the private sector. An informal study of current jobs listed on the website "gisjobs.com" included positions with the federal government (USEPA, USDA), state and local government (city, county), industry (e.g., software companies, consulting firms, location-based service providers), and academia (providing research support to interdisciplinary centers). Within these current employment opportunities, applications include resource management, spatial database development and management, environmental planning, transportation planning, software development, cartography, conservation, urban planning, and spatial decision support services.

Graduates of the proposed GIS major will be well-prepared for positions beyond routine use of geospatial technologies, and able to apply spatial analysis techniques to address sophisticated problems in a variety of fields. In addition, graduates of the proposed program will have begun to develop the business and communication competencies required for advancement in government agencies and private businesses.

Graduates of the proposed GIS major will also be very competitive for continued academic study, at OSU or other universities. Current trends in the discipline (as evidenced the "Jobs in Geography" website maintained by the Association of American Geographers [AAG]) are that graduates of doctoral programs in geography and cognate disciplines with GIS skills, expertise, and research interests are highly in demand.

11. Describe any licensure or certification for which this major will prepare students.

Given the relatively short history of GIS, certification of GIS programs is still a new phenomenon. The UCGIS Body of Knowledge (DiBiase et al. 2006) has clearly defined core competencies, which are the basis for a new certification system for GIS professionals by the GIS Certification Institute. This certification includes three components: educational achievement, professional experience, and contribution to the profession. Students in the new GIS major will be able to document and complete the educational attainment component of a GIS professional certificate.

III. GOALS/OBJECTIVES/EVALUATION

12. Provide a learning outcomes assessment plan for the major program.

A. State the general and specific educational goals and objectives for the major.

The general educational goals for the major are that students will:

1. learn how to operationalize fundamental concepts in Geographic Information Sciences.
2. achieve proficiency with methods of Geographic Information Sciences.
3. be provided with a strong foundation for seeking employment or graduate or professional training.

The specific educational goals for the major are:

1. **Technical:** Students will acquire an ability to assess relationships among geospatial technologies, GIS theory and applications, technical writing, and technological literacy.
2. **Analytical:** Students will become creative thinkers, acquire problem-solving skills, and demonstrate an ability to situate GIScience in a larger societal context.
3. **Communication:** Students will be able to represent complex technical information orally, visually, and in writing.

B. Indicate the methods that will be used to assess whether the educational goals and learning objectives are being met.

The Department of Geography currently has an assessment plan that includes a suite of outcome monitoring methods that allows us to gauge whether or not we are meeting pedagogical goals and to make necessary corrections. The plan is reviewed annually by the College of Social and Behavioral Sciences, and is overseen by our undergraduate advisor. The current plan consists of two indirect assessment methods and one direct method. Geography's assessment methods include:

- Embedded questions in one regularly offered and popular upper division course
- Informal focus groups with students in the major. In the 2007-2008 school year we conducted four such groups, one for each specialization.
- An exit survey of graduating seniors, which includes questions about the major regarding overall educational experience, classroom experience, research and internship participation, and placement in jobs and graduate school.

As part of the proposed overhaul of the Geography major, we have engineered an improved assessment strategy. As we gain experience with assessment and as the needs of the department change, we will refine our methods of assessment. We expect the result to be geography majors who are better prepared for graduate studies and the job market. Our plan includes continued use of focus groups and exit surveys with graduating seniors. We also include expanded use of embedded testing to reach 100% of our undergraduate majors.

Because the proposed GIS major will remain within the department of Geography, assessment for the GIS major will use the same techniques as assessment of the Geography major. We will include focus groups, exit surveys, and embedded testing techniques. Embedded testing will take place in the GIS Applications in Social Science and Business (686), and GIS Design and Implementation (687) courses. These classes are ideal for embedded testing because they not only teach methods and skills, but require students to express their general knowledge about concepts and methods in GIS and integrate these skills in an applied project. A group of faculty who specialize in GIS is currently developing a set of embedded questions for this class that will assess the department's success in teaching students technical, analytic, and communication skills.

C. Provide the time over which the assessment plan will be implemented.

Because the GIS major will remain within the Department of Geography, the above plan will be implemented immediately. We will continue to revisit our assessment methods, deciding which methods and techniques yield the most useful information. We currently produce an annual assessment report for the College of Social and Behavioral Sciences. For the new major, in Year 4 we will do an extensive additional report which looks at the educational experience of our first full cohort of GIS majors.

D. Describe how outcomes information will be used to improve student learning and program effectiveness.

1. The Undergraduate Studies Committee, in consultation with the undergraduate advisor, will review annual assessment data for GIS majors. These data will be used to make suggestions to faculty regarding content and pedagogical practice for existing courses in the GIS major.
2. The Undergraduate Studies Committee and the undergraduate advisor, along with an advisory committee of GIS-related faculty, will convene at the end of the third year to design a special assessment mechanism for the first graduating cohort. The group will meet again at the end of the fourth year to collate and analyze the data. These results will be used to consider more substantive changes of the GIS curriculum, including suggestions for any necessary new courses, course sequencing, and professionalization experiences such as internships and undergraduate research.

IV. RELATIONSHIP TO OTHER PROGRAMS

13. Describe current major and minor programs in the department(s) and how they relate to the proposed major.

Currently the Department of Geography offers BA and BS degrees in Geography, as well as a minor in Geography. A proposal for revision of the major is currently under review; the description here is of the current structure, with indication of important changes we are proposing.

Students majoring in geography choose one of four specializations: Analytical Cartography/Geographic Information Systems (BS), Urban and Regional Studies (BA), People-Society-Environment (BA), and Atmospheric and Climatic Studies (BS). These divisions represent long-standing core areas of knowledge in the geography discipline, and are mirrored at many of our peer institutions. The four specializations have unique, though overlapping, curricula that convey core geographical concepts and methods while allowing students to develop expertise in a particular area. The proposed structure retains these four tracks, renames them, and changes some of the requirements in them. Like the major, the minor in Geography has the same four specializations. Students are required to take five courses from a list of courses specific to each specialization.

As discussed in point 6, above, the proposed major in GIS relies extensively on the resources and structure of the Geography department. The courses for the new major already exist in the Geography department, current Geography professors comprise the faculty, and the department has a variety of resources (e.g. computer facilities) that will be available to students in the proposed major.

Approval of the current proposal for a major in GIS will allow for a separation of GIS training into two complementary levels. Within the geography major, the current Analytical Cartography/Geographic Information Systems specialization will become "Spatial Analysis" and will focus on geographical analysis methods in broader terms and provide a more general geographic education. (This Spatial Analysis specialization would be similar to the GIS major offered at Ohio University, which requires students to fulfill the requirements of the Geography major.) The proposed GIS major at OSU will provide full coverage of core knowledge areas in the GISciences, training students to become highly trained experts in their fields. We designed the two programs to attract and train different types of students. Students in the GIS major will be trained for professional careers specializing in spatial data, prepared to fill roles related to data acquisition and management, application development, training, data analysis, interpretation, and visualization. Students choosing the Spatial Analysis specialization will be prepared either for graduate school in Geography, or for careers that require them to use and plan for spatial information, for example in roles related to project management, systems analysis, coordination, training, and marketing. There is substantial overlap in the courses available to students in the two programs, which serves two purposes. First, students in both programs need to achieve adequate technical proficiency. Second, we want to provide maximum flexibility for students to design their programs around their specific interests and career paths. All students will be encouraged to design courses of study that take full advantage of the range of courses available.

An additional advantage of offering a GIS major is that it will allow students to pursue double majors. The GIS profession is highly interdisciplinary, as geospatial information is increasingly becoming a driving force for decision making across the local to global continuum. The GIS degree will likely be a popular complement to a degree in Geography, with focus in one of the other, substantive areas of specialization. This will allow students to combine sophisticated technical knowledge with in-depth knowledge in a substantive area (e.g. environmental issues, urban planning). The GIS degree will also be a popular complement to degrees in, *inter alia,* landscape architecture, city and regional and planning, computer science, natural resources, political science, and business. In addition many seeking a complement to their major will also benefit from a minor in GIS that will provide students with a general knowledge of geographical analysis methods.

14. Identify any overlaps with other programs or departments within the University. Append letters of concurrence or objection from related units.

Geodetic Science	603 Remote Sensing
	607 Fundamentals of Geographic Information Systems
	640 Decision-Making with GIS
	774 Spectral Methods and Raster Geometry in Digital Mapping
Civil Engineering	608 Spatial Analysis Techniques in Civil Engineering
City and Regional Planning	608 geographic Information Systems in Professional Planning Practice
Environment and Natural Resources	324 Natural Resources Photointerpretation

Concurrence letters are attached in Appendix D.

15. Indicate any cooperative arrangements with others institutions and organizations that will be used to offer this major.

None

16. Specify any articulation arrangements (direct transfer opportunities) with other institutions that will be in effect for the major.

None

17. Provide information on the use of consultants or advisory committees in the development of the major. Describe any continuing consultation.

This proposed major was developed by the Undergraduate Studies Committee, chaired by Professor Becky Mansfield, in consultation with an ad-hoc committee within the current Analytic Cartography/GIS specialization, headed up by Professor Ola Ahlqvist. Our evaluation of the specializations was inaugurated in WI07, with recommendations brought before the faculty in SP08. Faculty support for the changes was unanimous.

18. Indicate whether this major or a similar major was submitted for approval previously.

Neither this nor a similar major has been submitted previously.

19. Indicate where students will be drawn from, e.g. existing academic programs, outside of the University, etc. Estimate the mix of students entering the major internally and externally

Although it is extremely difficult to predict enrollment in our proposed GIS major, based on our current enrollment of approximately 35 majors per year in the GIS specialization, we estimate that the number of students enrolled in the GIS major will double by year four (see question 20, below).

Internal transfers: Our proposed major in GIS will, for the most part, draw students from the Geography major (current specialization in GIS). We are currently conducting a survey with our Geography majors as well as alumni in the GIS specialization, gauging their interest/opinion of a GIS major. At this point we expect most if not all of our current GIS students to transfer in the event that the GIS major is approved.

External entry: We expect that the new GIS major will attract a significant number of *new* students to OSU, both regionally and nationally. Faculty affiliated with the proposed GIS major will lead a major national-scale recruitment drive in the event that the major is approved. Given the high visibility of our faculty, we expect to draw a significant amount of interest.

Double major/minor: Given the multi-disciplinary nature of GIS it is likely that some students see the value of a double major or a minor in GIS as a way to augment their job placement or graduate studies opportunities.

Student mix: We anticipate very little disturbance to existing programs at OSU due to our proposed GIS major. Although some students will change to the GIS major from others such as Civil Engineering or Computer Sciences, we also expect that most new majors will be incoming freshman.

V. STUDENT ENROLLMENT

20. Indicate the number of students you anticipate will be admitted to the major each year

Regular Academic Year	Year 1	Year 2	Year 3	Year 4
Full-time (new entering)	35	8	10	12
Full-time (cumulative)	35	43	53	65
Part-time (new entering)	1	2	3	4
Part-time (cumulative)	1	3	6	10
Estimated Summer Enrollments	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Full-time	NA	NA	NA	NA
Part-time	NA	NA	NA	NA

Our estimated enrollment in full-time studies during the first four regular academic years is based on current enrollment figures for the GIS specialization in Geography. Since AU03 we have averaged 35 new majors per year in the GIS specialization.

VI. REQUIREMENTS

21. List the courses (Department, title, credit hours, description) which constitute the requirements and other components of the major. Indicate which courses are currently offered and which will be new. Append a quarter-by-quarter sample program and all New Course, Course Change, and Course Withdrawal forms necessitated by the implementation of the proposed major.

There are three components to the proposed GIS major: required prerequisites or supplements to the major, core requirements, and electives. (See Appendix C for schematic version and Appendix H for course syllabi)

The 9 hours of required prerequisites and supplements to the major include a choice of introductory computer programming classes (CSE 201 or 202), and Introduction to Statistical Analysis (STAT 245). These courses provide a computing and mathematical basis for further training in the major and are also in line with OSU requirements for a BS degree.

The core requirements component of the major consists of 45 credit hours, representing depth and breadth in the major subfields of GIS. The GIS sequence including Fundamentals of Geographic Information Systems (607), Intermediate GIS (685), GIS Applications in Social Science and Business (686), and GIS Design and Implementation (687). A sequence in the

subfield of cartography and geovisualization includes Map Reading and Interpretation (480), Elements of Cartography (580) and Computer Cartography and Geographical Visualization (680). These sequences in GIS and cartography are rounded out by the course Quantitative Geographical Methods (683) and Geographic Applications in Remote Sensing (684).

Finally, the third component of the proposed major is 8-10 hours of elective courses across Geography and Computer Science & Engineering. Two courses can be chosen from the following, depending on the student's interests and career goals: Geography of Transportation (645), Locational Analysis (647), Land Use Geography (655), Emerging Topics in GIS (688), Seminar in GIS (787), Undergraduate Seminar in Research and Professionalization (695), Earth Systems Data Collection and Analysis (Earth Sci 310), Data Structure for Information Systems (CS&E 214), Introduction to C++ Programming (CS&E 230), Object-Oriented Programming for Engineers and Scientists (CS&E 502), and Introduction to Database Systems I (CS&E 670). We note that those students wanting to take CS&E 214 should choose 201 as a prerequisite, while those wanting to take CS&E 230 or 502 should take 202; we also note that 502 is the prerequisite for 670.

22. State the minimum number of credits required for completion of the major.

53

23. State the average number of credits expected for a student at completion of the major.

We expect most students to have 54 major credit hours when they graduate, based on the average number of credits in the elective courses.

24. Give the average number of credits taken per quarter by a typical student. Estimate the average for each year.

The average number of credit hours is 15 per quarter, for a total of 45 per year. Credit hours vary depending on quarters and the time the GIS major is declared. Sample curricula with quarter by quarter credit hour estimates are shown in Appendix E.

25. Give the number of credits students are required to take in other departments.

The major requires 53-55 credit hours in Geography. The core consists of 45 credit hours (nine courses), all in Geography. Students are also required to take 8-10 credit hours (two courses) of electives. The elective list includes five courses from Geography and four from Computer Science & Engineering. All GEC requirements are taken outside Geography; these amount to 80-100 hours (depending on test placement). This leaves 26-46 free elective credit hours, which can be taken both inside and outside Geography.

26. Give the number of credits a typical student might take as electives in other departments.

20-40 credit hours

27. Describe other major requirements in addition to course requirements, e.g., examinations, internships, final projects.

None

28. Identify from which specialized professional association(s) accreditation will be sought. List any additional resources that will be necessary to gain such accreditation.

No such accreditation currently exists for GIS education.

29. Describe the number and qualifications of full-time and part-time faculty. List current faculty and areas of expertise. Describe the number and type of additional faculty needed

The Department of Geography currently has 24 full- or part-time tenure track faculty; seven of these are associated with GIS-related fields. For a list of faculty and specializations see Appendix F and Appendix G. We expect to hire one additional faculty member in this area in the 2008-2009 year, to replace a faculty member who recently resigned. Based on current enrollment patterns and projections, we do not expect to hire additional faculty in the next three years. However, we will consider making hires if justified by additional credit hours generated, in line with Social and Behavioral Sciences and OSU's budget model.

30. Describe existing facilities, equipment, and off-campus field experience and clinical sites to be used. Indicate how the use of these will impact other existing programs.

Computing requirement and lab space: GIS is a computer-intensive field, and Geography has significant computer facilities and space at its disposal. Our major undergraduate-only instructional computer lab (Derby 0140) comprises 50 state-of-the-art-work stations, with a full suite of GIS-relevant software. A sampling of the software loaded on all computers includes, but is not limited to: ArcGIS 9.2, ArcView 3.2 w/ 3D, Encarta, spatial statistics software, Geoda 0.95i, Google Earth, Google Sketchup, IDL 5.5.2 Student version, Illustrator, Mapobjects 2, Maptitude, .Net 1.1, Office 2003, PC GIS 3.2, R, SPSS, VB 6.0 as well as VB .NET.

DB0140 is managed by two full-time technical staff as well as a graduate student. The department is confident that our existing staff will be able to manage the increased traffic through our labs as a result of the GIS major.

Currently, on average, DB0140 is used for seven to ten courses per quarter, with peak hours of usage occurring between 9am and 5pm. This means that careful management of the lab will be required in order to accommodate the growth in GIS majors that we are predicting (see section 20). However, we are fully confident that our predicted enrollment numbers for Year 4 can be comfortably accommodated in the department, for the following reasons:

- There is currently little to no usage of DB0140 in the 7:30-9am slot, and no usage after 5pm. Geography is prepared to expand its use of early morning and late afternoon classes in order to adjust to more lab users as a result of the GIS major.

- Currently, utilization rates (i.e. the number of workstations used) in DB0140 seldom exceeds 50%. This means that we can easily accommodate a doubling of students in DB0140 in any given lab slot.

- There is sufficient physical space in DB0140 to expand the number of workstations by up to 30%, depending on demand as well as resources. We are currently updating the lab with 50 new computers. Although as of yet this will not result in any additional workstations in DB0140, we will be rebuilding the existing computers into 25 workstations to be allocated throughout the department as we see fit, including in the lab as required.

- We are currently moving ahead with a new spacious undergraduate resource center. This will be completed by the end of SU08. A portion of the older computers from DB0140 will be installed in the center so as to expand the number of computers available for use outside scheduled lab hours. We expect our future GIS majors to make substantial use of these machines.

- The department is also prepared to develop an additional undergraduate-only instructional lab should we require the space as a result of the proposed GIS major.

Regular classroom space: Of the nine core courses in our proposed GIS major, all have lecture as well as lab components. Approximately 30% of these courses involve simultaneous lectures and labs in DB0140. The other 70% of the classes require rooms for the lecture portion of the class, in addition to lab time and space. The only course which we do not teach exclusively in departmental classrooms is Geog 607, which is shared with Civil Engineering, City and Regional Planning, and Geodetic Science with lectures currently taught in Dreese 113. The rest of our classes are taught in DB1116, DB1080 and DB0155. Due to the ample size of these rooms, as well as departmental flexibility in allocating classroom usage, we foresee no classroom space restrictions based in the proposed GIS major. Additionally, the department regularly teaches courses in Paige Hall.

In sum, we expect little to no impact on other departments in terms of space use as a result of this proposal.

31. Describe additional University resources, including libraries, that will be required for the new major.

None

32. Describe the major as it would appear in the appropriate college bulletin.

The undergraduate Geographic Information Science (GIS) program concerns the nature of geographic information and the many applications of geospatial technologies, such as Geographic Information Systems. These include applications dealing with basic scientific questions as well as practical solutions for the workplace and everyday life activities. The science and technologies surrounding GIS are multi-disciplinary and range from conceptual geographic foundations, spatial data acquisition, modeling, analysis, and visualization, to societal, organizational, and ethical aspects of GIS.

The program is intended to prepare students for careers in the diverse areas of geospatial

applications. Because technology changes so rapidly, the program emphasizes general principles which will serve graduates throughout their careers, while giving students significant exposure and training in state-of-the-art software and technology. By design, students in the new GIS major will also be able to document and complete the educational attainment component of a GIS professional certificate.

Students graduating from OSU with a major in GIS will be well positioned to find gainful employment, both in the public and private sector. Graduates will be well-prepared for positions beyond routine use of geospatial technologies, and able to apply spatial analysis techniques to address sophisticated problems in a variety of fields. In addition, graduates will have begun to develop the business and communication competencies required for advancement in government agencies and private businesses. Graduates will also be very competitive for continued academic study, at OSU or other universities.

Students pursuing a major in geographic information science must complete 53-55 hours of approved courses.

References

DiBiase D W, DeMers, M N, Johnson A J, Kemp K K, Taylor-Luck A, Plewe B S, and Wentz E A (2006). Geographic Information Science and Technology Body of Knoweldge (First Edition). Washington DC, Association of American Geographers

Gewin, Virginia (2004). Mapping opportunities. *Nature* 427: 376-377.

Appendix A

UCGIS Geographic Information Science and Technology Body of Knowledge 2006 (DiBiase et al. 2006)

Knowledge areas (underlined) are clusters of knowledge, skills, and applications that span the breadth of GIScience. Units are coherent sets of topics that embody representative concepts, methodologies, and applications, designed as either core (bold face) or elective (normal face).

Knowledge Area AM. Analytical Methods
Unit AM1 Academic and analytical origins
Unit AM2 Query operations and query languages
Unit AM3 Geometric measures
Unit AM4 Basic analytical operations
Unit AM5 Basic analytical methods
Unit AM6 Analysis of surfaces
Unit AM7 Spatial statistics
Unit AM8 Geostatistics
Unit AM9 Spatial regression and econometrics
Unit AM10 Data mining
Unit AM11 Network analysis
Unit AM12 Optimization and location-allocation modeling

Knowledge Area CF. Conceptual Foundations
Unit CF1 Philosophical foundations
Unit CF2 Cognitive and social foundations
Unit CF3 Domains of geographic information
Unit CF4 Elements of geographic information
Unit CF5 Relationships
Unit CF6 Imperfections in geographic information

Knowledge Area CV. Cartography and Visualization
Unit CV1 History and trends
Unit CV2 Data considerations
Unit CV3 Principles of map design
Unit CV4 Graphic representation techniques
Unit CV5 Map production
Unit CV6 Map use and evaluation

Knowledge Area DA. Design Aspects
Unit DA1 The scope of GI S&T system design
Unit DA2 Project definition
Unit DA3 Resource planning
Unit DA4 Database design
Unit DA5 Analysis design
Unit DA6 Application design
Unit DA7 System implementation

Knowledge Area DM. Data Modeling
Unit DM1 Basic storage and retrieval structures
Unit DM2 Database management systems
Unit DM3 Tessellation data models
Unit DM4 Vector and object data models
Unit DM5 Modeling 3D, temporal, and uncertain phenomena

Knowledge Area DN. Data Manipulation
Unit DN1 Representation transformation
Unit DN2 Generalization and aggregation
Unit DN3 Transaction management of geospatial data

Knowledge Area GC. Geocomputation
Unit GC1 Emergence of geocomputation
Unit GC2 Computational aspects and neurocomputing
Unit GC3 Cellular Automata (CA) models
Unit GC4 Heuristics
Unit GC5 Genetic algorithms (GA)
Unit GC6 Agent-based models
Unit GC7 Simulation modeling
Unit GC8 Uncertainty
Unit GC9 Fuzzy sets

Knowledge Area GD. Geospatial Data
Unit GD1 Earth geometry
Unit GD2 Land partitioning systems
Unit GD3 Georeferencing systems
Unit GD4 Datums
Unit GD5 Map projections
Unit GD6 Data quality
Unit GD7 Land surveying and GPS
Unit GD8 Digitizing
Unit GD9 Field data collection
Unit GD10 Aerial imaging and photogrammetry
Unit GD11 Satellite and shipboard remote sensing
Unit GD12 Metadata, standards, and infrastructures

Knowledge Area GS. GI S&T and Society
Unit GS1 Legal aspects
Unit GS2 Economic aspects
Unit GS3 Use of geospatial information in the public sector
Unit GS4 Geospatial information as property
Unit GS5 Dissemination of geospatial information
Unit GS6 Ethical aspects of geospatial information and technology
Unit GS7 Critical GIS

Knowledge Area OI. Organizational and Institutional Aspects
Unit OI1 Origins of GI S&T
Unit O2 Managing the GI system operations and infrastructure
Unit OI3 Organizational structures and procedures
Unit OI4 GI S&T workforce themes
Unit OI5 Institutional and inter-institutional aspects
Unit OI6 Coordinating organizations (national and international)

Appendix B

Current Geographic Information Sciences (GIS) Curriculum

Part A. Required Prerequisites or Supplements to the Major (Credits count towards the major)

1. CS&E 201
2. Statistics 245

Part B. Core Requirements

1. Elements of Cartography 580
2. Fundamentals in Geographic Information Systems 607
3. Numerical Cartography 680
4. Introduction to Geographic Analysis 683
5. Intermediate Geographic Information Systems 685
6. GIS in Social Science and Business Research 686 or Design and Implementation of Geographic Information 687
7. CS&E 214 or CS&E 230

Part C. Electives within the Major

1. Choice of human geography course at the 600 level
2. Choice of one physical geography course from:
    - Physical Geography and Environmental Issues 210
    - Climatology 520
    - Integrated Earth Systems: Confronting Global Change 597.02
3. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix C

Proposed Geographic Information Science (GIS) major

Part A. Required Prerequisites or Supplements to the Major. (Do not count toward the 53-55 hour major)

1. CS&E 201 (Elementary Computer Programming; Java is taught) or 202 (Introduction to Programming and Algorithms for Engineers and Scientists; C++ is taught)
2. Statistics 245

Part B. Core Requirements (45 credit hours)

1. Map Reading and Interpretation 480
2. Elements of Cartography 580
3. Fundamentals in Geographic Information Systems 607
4. Computer Cartography and Geographic Visualization 680
5. Quantitative Geographical Methods 683
6. Geographic Applications of Remote Sensing 684
7. Intermediate Geographic Information Systems 685
8. GIS Applications in Social Science and Business 686
9. GIS Design and Implementation 687

Part C. Electives (6-10 credit hours)

1. Choose two of the following courses:
    - Geography of Transportation 645
    - Locational Analysis 647
    - Land Use Geography 655
    - Emerging topics in GIS 688
    - Seminar in GIS 787
    - Undergraduate Research and Professionalization Seminar 695
    - CS&E Data Structures for Information Systems 214 (4 credits)
    - CS&E Introduction to C++ Programming 230 (4 credits)
    - CS&E Object-Oriented Programming for Engineers and Scientists 502 (3 credits)
    - CS&E Introduction to Database Systems I 670 (3 credits)
        - For the above courses, CS&E suggests that students who have taken 201 for their prerequisite take 214, while those who have taken 202 should choose 230 or 502. The prerequisite for 670 is 502.
    - Earth Sci 310 Earth Systems Data Collection and Analysis

2. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix D

Concurrence

We will be attaching concurrence letters as they are received.

Appendix E

Sample 4-year plan for the GIS major (on the next page)

Sample four year plan B.S. Geographic Information Science			
Year 1			
Autumn	**Winter**	**Spring**	**Summer**
English 110	Math 151	Math 152	
Math 150	First GEC Natural Science course	Second Foreign Language course	
Geography 200 or 240 (GEC Social Science course)	First Foreign Language course	Visual/Performing Arts	
University Survey course (1hour)			
Year 2			
Autumn	**Winter**	**Spring**	**Summer**
Geography 480	Geography 580	Geography 607	
CS&E 201	GEC Second Writing course (367's)	Statistics 245	
Third GEC Foreign Language	Fourth GEC Foreign Language	First GEC Historical Study course	
Year 3			
Autumn	**Winter**	**Spring**	**Summer**
Geography 683	Geography 680	Geography 686	
Second GEC Historical Study	Geography 685	Third GEC Natural Science course	
Second GEC Natural Science	Literature	Minor or General Elective course	
Year 4			
Autumn	**Winter**	**Spring**	**Summer**
Geography 687	GIS Major Elective	Fourth GEC Natural Science	
Geography 684	First Additional Breadth course	GIS Major Elective	
Second GEC Social Science	Second Additional Breadth course	Minor or General Elective course	

Appendix F

List of GIS Geography Faculty, with Area of Expertise

Name	Area of expertise	Faculty Status	Percent of Time
Ola Ahlqvist	uncertainty and semantics, visualization, land-use & land-cover change	Core Faculty (Assistant Professor)	100%
Marie Cieri	Qualitative and critical GIS, GIS and society, representation	Core Faculty (Assistant Professor)	100%
Mei-Po Kwan	3-D GIS, qualitative and critical GIS, travel behavior and accessibility	Core Faculty (Professor)	100%
Desheng Liu	spatial statistics, land-use & land-cover change, remote sensing of the environment	Core Faculty (Assistant Professor)	75%
Darla Munroe	Environmental modeling , urban, regional, and natural resource planning and development, environmental valuation	Core Faculty (Assistant Professor)	100%
Morton O'Kelly	spatial interaction, spatial optimization, service location models	Core Faculty (Professor)	100%
Ningchuan Xiao	geocomputation, information and communication technologies	Core Faculty (Assistant Professor)	100%

Appendix G

List of Other Geography Faculty

Name	Faculty Status	Percent of Time
Jason E. Box	Core Faculty (Associate Professor)	100%
David H. Bromwich	Core Faculty (Professor)	100%
Mathew Coleman	Core Faculty (Assistant Professor)	100%
Kevin R. Cox	Core Faculty (Professor)	100%
Nancy Ettlinger	Core Faculty (Associate Professor)	100%
Jay S. Hobgood	Core Faculty (Associate Professor)	100%
Jialin Lin	Core Faculty (Assistant Professor)	100%
Ed Malecki	Core Faculty (Professor)	100%
Becky Mansfield	Core Faculty (Associate Professor)	100%
Bryan Mark	Core Faculty (Assistant Professor)	100%
Kendra McSweeney	Core Faculty (Associate Professor)	100%
Yuri V. Medvedkov	Core Faculty (Professor)	100%
Ellen Mosley-Thompson	Core Faculty (Professor)	100%
David Porinchu	Core Faculty (Assistant Professor)	100%
Jeff Rogers	Core Faculty (Professor)	100%
Mary Thomas	Core Faculty (Assistant Professor)	50%
Joel Wainwright	Core Faculty (Assistant Professor)	100%
John Arnfield	Emeritus Faculty	
Larry Brown	Emeritus Faculty	

S. Earl Brown	Emeritus Faculty	
Emilio Casetti	Emeritus Faculty	
Howard Gauthier	Emeritus Faculty	
Henry Hunker	Emeritus Faculty	
Duane Marble	Emeritus Faculty	
Harold Moellering	Emeritus Faculty	
Joel Morrison	Emeritus Faculty	
John Rayner	Emeritus Faculty	

Appendix H

Syllabi for courses in the proposed GIS major

(Syllabi start on the next page.)

Geog 480: Map Reading and Interpretation

Autumn 2008
M, W 8:30 – 10:18, Derby 1116

Instructor:

Dr. Marie Cieri, Derby 1152 247-7371; cieri.1@osu.edu Office hours: M 10:30 – 12:30 (or by appt.)

Course Description

Maps and map-like objects have played an important role in societies across the globe for centuries. Now, with the increased capacity to explore, analyze and describe spatial data through digital technologies such as geographic information systems (GIS) and the Internet, maps have become ever more prominent features of our contemporary world. This course will introduce students to the many ways maps and the process of mapping have been and are now used by geographers and scores of other social actors – public administrators, planners, developers, marketers, the military, the news media, historians, scientists, financiers, politicians, agriculturalists, artists, the police, architects, environmentalists, tourism promoters, vacationers, realtors, you name it! We will learn how to read and interpret maps of many types, vintages and cultural origins, and one of the chief ways we will do this is by making maps of our own using tools that are readily available on the Internet. Pertinent topics such as data sources, generalization and map "infrastructure" (scale, projections, reference systems, accuracy) will be covered. No previous experience with map-making or GIS is required, and students from disciplines outside geography are welcome to enroll.

Course Prerequisites

No previous experience with map-making or GIS is required, though some familiarity with the Internet is important.

Readings

The required readings for this course will be available through Carmen, a reader that will be available at SBX later in the quarter, and from your instructor.

These readings and the extensive web-based notes and images are your primary sources for this course. Tests, exercises and projects are based on lecture material and assigned readings. Lectures do not follow the readings point by point -- there is a substantial amount of material presented in class that isn't in the readings. It is therefore very important not only to attend class but to arrive on time and stay for the entire class period.

Please bring readings to the class for which they are assigned, as we will be referring to them frequently. Due dates for required readings are noted on the course schedule.

Students also will be required to purchase a map for the course (instructions provided in class) which should cost around $6.

Exercises

Six exercises will be assigned. Most of these will involve work on the Internet. Students having problems with access to the Internet should talk to the instructor as soon as possible. Completed exercises must be turned in on time (late work will be penalized 5% per day, including weekends). Exercises will be linked to the course schedule and exercise pages. Additional in-class exercises will occasionally be assigned.

Computer Skills

Students in Geography 280 will be expected to use a computer with Internet capabilities for accessing lecture outlines, exercises, and instructions for the final project. You should check OSU's website for information on other computer labs you can use if you don't have your own computer with web access. If you need any help with the computer skills needed for Geography 280, please ask me.

Evaluation

- 2 tests @ 100 pts. each = 200 pts.
- Final project = 200 pts.
- Exercises = 200 pts.
- Student reports = 50
- Participation = 100 pts.
- One unexcused absence allowed; after that, your final, total grade will be reduced by 3% for each absence unless you have a written medical excuse.
- Grading options for the course are A, A-, B+, B, B-, C+, C, C-, D+, D or E.

Academic Misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-847). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Disability Services: Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD292-0901; http://www.ods.ohio-state.edu/.

Other Policies

- No make-up exams will be given (except with a written medical excuse, at the discretion of the instructor).

Course Schedule (Note: subject to change; changes will be announced in class and on the online class page/course schedule):

Readings should be completed by the class period for which they are listed.

Lecture outlines, can be accessed through the online schedule. Your instructor usually will post updated lectures just prior to the pertinent class period.

Note on the lecture outlines and exams: students who take notes along with the lectures and refer to them while reviewing the lecture outline materials do the best on exams. The lecture outlines are not a substitute for attending class or taking notes.

Wed. Sept. 19: Introduction to the Course

Mon. Sept. 24: Maps and Human Understanding + Mental Maps Readings Due: *National Geographic* article "Revolutions in Mapping" and *NY Times* article "Submarine Crash Reveals Gap in Navy Map System."

Wed. Sept.26: Cartographic Maps Readings Due: Krygier and Wood, *Making Maps*, pp. 26-33 of "Why Are You Making Your Map?"; and pp. 70-83, "Map-Making Tools." **Due:** Exercise 1: Mental Mapping

Mon. Oct. 1: Finding "Real" Maps -- **Meet in the Map Library at 8:45 a.m.** Reading Due: Wood, "Maps Work by Serving Interests."

The Map Library is located in Ackerman Library, 610 Ackerman Rd. on the West Campus. OSU Map Librarian Steve Rogers will provide an orientation to the university's map collections, and we'll do some exploring on our own as well. You should also take this opportunity to work on Exercise 2 in the library.

Wed. Oct. 3: A Cultural History of Maps Readings Due: Godlewska, "The Idea of the Map" and Monmonier, "Going Native."

Mon. Oct. 8: Computers and Mapping

Reading Due: Dorling and Fairbairn, "Geographical Information Systems" **Due:** Exercise 2: Finding "Real" Maps

Wed. Oct. 10: The Environment to be Mapped and Review for Test I

Mon. Oct. 15: **Test 1** and Geographic Data

Wed. Oct. 17: Geographic Data Reading due: Krygier and Wood, "Mappable Data" **Due:** Exercise 3: TBA

Mon. Oct. 22*:* Geographic Data (cont.) + Map Abstraction Reading due: Krygier and Wood, "Map Generalization and Classification"

Wed. Oct. 24: Map Abstraction (cont.) Reading Due: Krygier and Wood, "Map Symbolization" **Due:** Exercise 4: TBA

Mon. Oct. 29: **No class** (I'll be on my way back from a symposium about mapping, in Los Angeles).

Wed. Oct. 31: Map Reference Systems Readings due: Krygier and Wood, "Geographic Framework" and Paumgarten, "Getting There."

Due: Exercise 5: TBA

Mon. Nov. 5: Map Projections

Readings due: Krygier and Wood, pp. 91-109 of "Geographic Framework"

Wed. Nov. 7: Map Projections (cont.) + Review for Test 2

Due: Exercise 6: Map Projections

Mon. Nov. 12: **No class** – Veterans Day

Wed. Nov. 14: **Test 2** + Focus on Maps in Society 1

Mon. Nov. 19: Focus on Maps in Society 2 Readings Due: Monmonier, "Census Maps"

Students report on individual readings and/or on mapmaking assignments

Wed. Nov. 21: Focus on Maps in Society 3 Students continue to report on individual readings and/or mapmaking assignments.

Mon. Nov. 26: Focus on Maps in Society 3 + discussion of progress on Final Projects

Students show final project works-in-progress

Wed. Nov. 28: Focus on Maps in Society 4 + Course Conclusions Students continue to show final project works-in-progress

Final Project Due: Mon., Dec. 3, by 5 p.m.

Please leave your final project in my mailbox in Derby 1036

GEOG 580: Elements of Cartography

Instructor

Ola Ahlqvist, ahlqvist.1@osu.edu

Office phone: 247-7997 Office address: 1049 Derby Hall, 154 N Oval Mall Office hours: Wednesdays 10 AM - noon, or by appointment (or drop-in but then I reserve the right to busy)

Teaching Assistant

Tim Hawthorne, hawthorne.20@osu.edu

Office address: 1145 Derby Hall, 154 N Oval Mall Office hours: Mondays 2:30-4 pm, or by appointment

Course Description

"*Show me a geographer who does not need them [maps] constantly and want them about him, and I shall have my doubts as to whether he has made the right choice in life."* Carl O. Sauer (1889-1975)

This is an introduction to the art, craft, and science of cartography. Modern technology has changed cartography from a largely manual pen-and-paper based craft to an interactive computer based process. The full implications of this transition remain to be seen but basic principles of cartographic communication will still remain important. Throughout this course we will emphasize important aspects of cartographic communication; map purpose, geographic phenomena and their measurement, data manipulation such as classification and generalization, and various map design issues.

Much emphasis is put on hands-on experience for you to learn to apply visual and cartographic techniques to spatial information. An exciting component this quarter will be a close collaboration with the African American and African Studies Community Extension Center. Through this you will have an opportunity to learn what a real life mapping project might look like, from initial discussions of mapping needs, through the various stages of map design, to the final delivery.

Text

Dent, B. , 1999, Cartography – Thematic Map design, McGraw Hill, 448p.

Perthes World Atlas, 1st Ed., Klett International, 315p.

Both texts are required, but the publisher has promised me a bundle, ISBN 9780073506548, that should give you a good price on both.

Tentative Schedule

The most up to date schedule will always be posted on Carmen under Course info. Any significant changes to the schedule will be announced well in advance.

Classes

Tuesdays and Thursdays 12:30 PM — 2:18 PM in 0140 Derby Hall.

Class material such as lecture notes, worksheets, handouts will be made available through Carmen under the heading Lectures.

During lectures we will often spend some time to work with sample problems and discuss practical applications. These activities are meant to build a deeper understanding of the subject matter but it also relies heavily on your active participation. You will also sometimes have work to prepare before classes or other types of homework assignments.

Labs

Labs are also in **0140 Derby Hall** and follow directly after the lectures **Tuesdays and Thursdays 2:30 PM — 3:18 PM**. Details on the labs will be posted on Carmen under the Labs heading

Grading Policy

Overall credits for the course are given approximately as follows:

Lab Assignments	~450 points (or ~45%)
In-class work & Homework	~135 points (or ~13%)
Term project and related work	~215 points (or ~22%)
Exams	~200 points (or ~20%)

The credits given to each course component reflects my notion that I can only facilitate for you to acquire theoretical and practical knowledge. *Only you can learn* what we want you to. Consequently, assessments relate mainly to your own learning, such as demonstrating practical use of the covered topic matter in lab, homework and an individual project.

Final letter grades will be assigned based on how many percent of total points available you have earned.

92 <= A 90 <= A- < 92 88 <= B+ < 90 82 <= B < 88 80 <= B- < 82 78 <= C+ < 80 70 <= C < 78 60 <= D < 70 F < 60

Examination Policy

All course work (labs, homework, individual project work) are expected by the due date. A late penalty of at least 10 percentage units will be taken off each day after the due date.

If you have a genuine reason (known medical condition, a pile-up of due assignments on other courses, ROTC, athletics teams, job interview, religious obligations etc.) for being unable to complete work on time, then some flexibility is possible. However, if in my judgment you could reasonably have let me know *beforehand* that there would likely be a delay, then a late penalty will still be imposed if I don't hear from you until *after* the deadline has passed. For unforeseeable problems, I may be more flexible. If there are ongoing medical, personal, or other issues that are likely to affect your work all semester, then please arrange to see me in the first full week of the quarter to discuss the situation.

Lab Assignments: You are welcome to discuss the labs amongst yourselves, in fact this is encouraged, but the final product you hand in *must be your own work* (see Academic Integrity Policy above). Details of the lab assignments will be posted on the course web site.

In-class work & Homework: Most classes have time allotted for discussions, in-class work and other activities. Your contribution in these and in class generally, will be noted, and used to determine part of your final grade, just showing up won't count a whole lot toward this component! Obviously, you will receive no credit for in-class work if you are not present.

During the quarter, there will be several homework assignments. The main purpose of the homework is to provide an opportunity to learn how to apply the things we cover during the lectures, and to help you and me to assess your own progress. Homework will be assigned during class, and usually due by the next class period. If you are having difficulty with assignments you should get help, whether from fellow students, from the course TA, or from me. Whatever you do, ask someone!

Exam: There will a continuous evaluation through lab, homework and in-class assignments. In addition there will be four smaller exams. These exams will be given in class, will cover material from the lectures and assignments, and will consist of multiple choice, short answer, and problem solving questions. There will be no final exam; instead an individual project will assess your ability to apply what you have learned in a practical situation.

Term project: Details of the individual project will be posted on Carmen .

There will be no make-up exams or labs except for *documented* medical or family emergencies.

Academic Integrity Policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term

"academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-847). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Disability Services

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/ .

INTERDISCIPLINARY 607: CE/CRP/GEOG/GEOL/GS 607
Fundamentals of Geographic Information Systems

Autumn Quarter 2008

Course Description: Basic principles of geographic and land information systems and their use in spatial analysis and information management.

Course Coordinator: Mei-Po Kwan, Professor, Geography (Room 1054, Derby Hall, 292-9465, kwan.8@osu.edu).

Objectives of the Course: The course is designed to give students an understanding of geographic information systems, their capabilities, uses, and limitations. Relevant applications for each discipline area are demonstrated in the computer laboratory portion.

Textbook: P.A. Longley, M.F. Goodchild, D.J. Maguire, and D.W. Rhind (editors), 2005. *Geographic Information Systems and Science.* 2nd edition, John Wiley & Sons, Inc.

Class website: http://carmen.osu.edu

Call #	*Department*	*Day*	*Time*	*Location*	*Instructor*
05156-0	Civil Engineering	Tue	9:30-11:18 A.M.	HI 322	Merry
05053-5	City & Reg Planning	Thu	5:30-8:18 P.M.	KN 430	Gordon
10299-8	Geography	Mon	10:30-12:18 P.M.	DB 140	Kwan
10300-	Geography	Wed	10:30-12:18	DB 140	Kwan

0			P.M.		
10199-0	Geodetic Science	Tue	9:30-11:18 A.M.	HI 322	Merry
10689-4	Geological Sciences	Tue	5:30-8:18 P.M.	ML 356	Pride
10690-1	Geological Sciences	Wed	5:30-8:18 P.M.	ML 356	Pride

Lab Instructors Email Office
Steve Gordon (SG) sgordon@osc.edu KN 290 – 275 W Woodruff Ave
Mei-Po Kwan (MK) kwan.8@osu.edu DB 1054 – 154 N Oval Mall
Carolyn Merry (CM) merry.1@osu.edu HI 470 – 2070 Neil Ave
Doug Pride (DP) pride.1@osu.edu ML 275 – 125 S Oval Mall

Lecture Format:
The course will be team-taught, with three lectures per week in a large auditorium (Dreese Lab 113) from 12:30-1:18 MWF. This is a complex syllabus; there may be changes or corrections announced in class.

Date	*Lecturer*	*Topic*	*Chapter Readings*
Wed, Sept 19	Kwan	Introduction	Ch 1
Fri, Sept 21	Gordon	Introduction to spatial data	Ch 3, esp. 68-74; 80-83
Mon, Sep 24	Ahlqvist	Maps and map analysis	Ch 3: 64, 67-69, 76-81, Ch 5: 115-121, Ch 12
Wed, Sep 26	Ahlqvist	Maps and map analysis	Ch 3: 64, 67-69, 76-81, Ch 5: 115-121, Ch 12
Fri, Sep 28	Merry	Raster GIS	Ch 3: 63-83
Mon, Oct 1	Merry	Raster GIS	Ch 3: 63-83
Wed, Oct 3	Munroe	Vector GIS	Ch 3, 8, 14
Fri, Oct 5	Munroe	Vector GIS	Ch 3, 8, 14
Mon, Oct 8	Merry	Data in GIS: remote sensing	Ch 9: 199-216
Wed, Oct 10	Xiao	Spatial databases	Ch 10: 218-228

Fri, Oct 12	Xiao	Spatial databases	Ch 10: 218-228
Mon, Oct 15	Liu	Data in GIS: acquisition	Ch 9
Wed, Oct 17	Liu	Data in GIS: editing, data quality	
Fri, Oct 19	Xiao	Data in GIS: storage	Ch 10: 229-234
Mon, Oct 22	Gordon	GIS capabilities	Ch 14, 15
Wed, Oct 24	Gordon	GIS capabilities	Ch 14, 15
Fri, Oct 26	Ahlqvist	GIS visualization	Ch 13
Mon, Oct 29	Gordon	GIS implementation	Ch 17
Wed, Oct 31	Gordon	GIS implementation	Ch 17
Fri, Nov 2	Merry	GIS applications in civil engineering	
Mon, Nov 5	Gordon	GIS applications in city and regional planning	Ch 2, 15
Wed, Nov 7	Kwan	GIS applications in geography	
Fri, Nov 9	Crecelius	GIS applications in natural resources	
Mon, Nov 12		Holiday	
Wed, Nov 14	Pride	GIS applications in geology	Ch 2: 35 – 60
Fri, Nov 16	Pride	GIS applications in geology	Ch 2: 35 – 60
Mon, Nov 19	Murray	GIS applications in geography	
Wed, Nov 21	Davis	GIS activities in Ohio	
Fri, Nov 23	-	Thanksgiving Break	
Mon, Nov 26	Merry	The future of GIS; Ethics in GIS	Ch 21: 471-486
Wed, Nov 28	Elhami	GIS applications in real estate	
Fri, Nov 30	Kwan	Review & wrap-up	

Tue, Dec 4		Final Exam – 11:30-1:18 P.M.	

Course Syllabus

1. Introduction (MK)
   a. Basic concepts
   b. What is a GIS?
   c. Users of GIS
   d. History of GIS
   e. Recent developments

2. Introduction to spatial data (SG)
   a. Spatial elements – points, lines, areas and surfaces
   b. Spatial measurement levels
   c. Spatial location and reference
   d. Spatial relationships
   e. GIS data models
   f. Attribute data

3. Maps and map analysis (OA)
   a. Map elements and their properties
   b. Real and virtual maps
   c. Map projections, distortions and transformations
   d. Map referencing – direct, relative
   e. Mapping principles applied to digital maps and spatial analysis
   f. Coordinate systems

4. Vector GIS (DM)
   a. Vector data and its characteristics
   b. Advantages and limitations of vector mapping systems
   c. Topology
   d. Vector GIS capabilities
   e. TIN model
   f. Network model
   g. Connectivity

5. Raster GIS (CM)
   a. Raster data and its characteristics
   b. Advantages and disadvantages of raster mapping systems
   c. Raster functions – raster data overlay, buffers
   d. Grid model; DTM
   e. Accuracy
   f. Quadtree model

6. Spatial databases (NX)
 a. Basic file structures
 b. Data structures – relational, hierarchical, network
 c. Integration of spatial, attribute and topological data
 d. Object-oriented databases

7. Data in a GIS – acquisition (DL)
 a. Digitizing
 b. Scanning
 c. Surveying
 d. GPS data
 e. Photogrammetry
 f. Metadata

8. Data in a GIS – editing, data quality (DL)
 a. Accuracy vs. precision
 b. Measurement of logical consistency
 c. Completeness; lineage; timeliness; attribute data accuracy
 d. Accessibility needs
 e. Available tools
 f. Sources of error

9. Data in a GIS – storage (NX)
 a. Geometry
 b. Attributes
 c. Distributed
 d. SQL
 e. Database design
 f. User interfaces

10. Data in a GIS – remote sensing (CM)
 a. Electromagnetic spectrum
 b. Images – aircraft and satellite
 c. Radiometric and geometric correction
 d. Supervised vs. unsupervised classification

11. GIS capabilities (SG)
 a. Spatial objects, measurements and models
 b. Application of measures
 c. Proximity and contiguity analysis
 d. Map data retrieval and search; map overlay; classification and reclassification
 e. Neighborhood functions
 f. Cartographic algebra
 g. Logic & geometric operations
 h. Network representation

i. Hydrologic modeling

12. GIS implementation (SG)
a. Requirement analysis and system design
b. Time and cost analysis for data, hardware and software
c. Cost/benefit analysis of GIS
d. Organization issues
e. Choosing hardware and software
f. Operation and maintenance

13. GIS visualization (OA)
a. Data to display
b. Cartographic considerations
c. Map symbols
d. Potentials and limitations

14. GIS applications (CM, SG, DP, MK, AM)
a. Geography/human resources
b. Geology
c. Transportation/engineering
d. Environment/natural resources

15. Ethics in GIS (CM)

16. The future of GIS (CM)
a. Technological developments
b. New applications
c. Data access
d. Research and development

Weekly Lab & Quiz Schedule:

Week of:	*Lab*	*Lab Due:*
September 24	Pass out & work on Lab 1	Lab 1 due: 8, 9, 10, 11 October
October 1	Continue work on Lab 1 – Quiz 1	
October 8	Pass out Lab 2	Lab 2 due: 22, 23, 24, 25 October
October 15	Continue work on Lab 2 – Quiz 2	
October 22	Pass out Lab 3	Lab 3 due: 5, 6, 7, 8 November
October 29	Continue work on Lab 3 – Quiz 3	

November 5	Pass out Lab 4	Lab 4 due: 19, 20, 21, 22 November
November 12	Continue work on Lab 4 – Quiz 4	
	Pass out Lab 5	Lab 5 due: 30, November
November 26	Continue work on Lab 5 – Quiz 5	

Grading will be based on five lab exercises, five quizzes, and a final exam. The exercises will count for 60% of the grade, the quizzes 15%, and the final exam is 25% of the grade.

Computer laboratories:

Each department that sponsors the interdisciplinary course is responsible for developing, delivering, monitoring and grading an appropriate set of laboratory exercises. All participating departments will include an agreed upon common minimum set of exercises for each lab. Each department may also assign its own weight to the lab assignments. Lab assignments will include the following:

Lab 1. *Introduction to ArcGIS, Geodata, and Map Projections.* Using ArcGIS, students will become familiar with the ESRI ArcGIS software, explore different types of geodata available, learn basic database operations, and learn about the different types of map projections. Specific objectives include learning how to use ArcGIS; the types of geodata in a GIS environment – vector, raster and images; how to display data in ArcGIS; types of map projections; and how to generate a meaningful map. (2 weeks)

Lab 2. *Vector Data Operations.* Using ArcGIS, students will become familiar with vector data operations. Specific objectives are to perform visual interpretations of vector data, learn vector buffer operations, and learn basic vector operations using the ArcGIS GeoProcessing wizard. (2 weeks)

Lab 3. *Raster Data Operations.* Using ArcGIS, students will become familiar with raster data and learn simple data manipulations in a raster system. Specific objectives are to understand and learn general aspects and display of raster data (grid dataset), map algebra/data reclassification, and raster buffer operations. (2 weeks)

Lab 4. *Data Relations.* The purpose of this lab is to become familiar with data relationships in a GIS. Specific objectives are to understand the relationships in datasets and attribute/spatial relations, and to learn the difference between a join and relate operation. (2 weeks)

Lab 5. *Applications of GIS – Final Project.* Students will perform a spatial analysis exercise, given only the criteria to use for reaching a conclusion. Objectives are to explore a data set and the geographic distribution of the variables and to arrive at several conclusions. Other objectives include learning to design and perform the necessary data analysis in a vector-based or raster-based GIS. Data export utilities to other applications, such as Microsoft Access or Excel, will be learned for developing a more complete statistical analysis of spatial data. (2 weeks)

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GEOG 645: Transportation Geography

Spring Quarter 2009
The Ohio State University

Instructor: Michael Niedzielski [niedzielski.4@osu.edu]
Class Location: TO 0247
Call Number: 09999-6
Class Time: Tue, Thur 12:30-2:18pm
Office: 1145 Derby Hall
Office Hours: Tue, Thur 2:30-4pm
Phone: 292-6127

T/A: Hyun Kim [kim.1567@osu.edu]
Phone: 292-1357
Office: 1131 Derby Hall
Office Hours: Mon, Wed 1pm-2:30pm

Course Description:

The course presents a review of the geography of transportation. Four major sets of ideas are discussed:

1) Introduction to Spatial Organization
    1) Spatial organization using concepts of linkage, node, hierarchy, and hinterland.
    2) Selected economic explanations and models of trade.
    3) Spatial interaction (gravity) models.

2) Network Analysis
    1) Aggregate or descriptive measures.
    2) Disaggregate or detailed descriptive measures.

3) Allocation Methods
Provides an example of optimal flow, where we aim to achieve efficient flows within a given network

4) Urban Transportation
Introduction to other selected urban transportation problem areas.

The emphasis is on three different interrelated approaches to understanding the geography of transport: [a] description, [b] explanation, and [c] normative or optimal models. The first type of approach asks "where? and what?" kinds of questions; the second approach asks "why?" questions; and the third approach deals with "how?" could a system be improved.

Course Text:

Taaffe, Gauthier, and O'Kelly, *Geography of Transportation*, Second Edition available at UniPrint at the Tuttle UniPrint Center (by Tuttle garage near the University Bookstore) and its cost is approximately $35.

Course Requirements

Exercise I 15 pts Handed out Apr 10, due Apr 19 by 5:00 pm in my mailbox with a timestamp from the Geography Dept. main office
Exam I 30 pts Tue, Apr 24
Exercise II 15 pts Handed out Apr 26, due May 8 by 5:00 pm in my mailbox with a timestamp from the Geography Dept. main office
Exam II 40 pts Thur, May 31

No e-mail submissions accepted
Penalties of 20% per day will be assessed for late projects [i.e. maximum score after 1 day late is 80%]. It is the student's responsibility to ensure the instructor receives the material on time. Exam II covers material after Exam I.

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Course Content

Week	Day	Date	Meeting Topics		Read
1	T	Mar 27	1	Introduction, Spt. Organization	Chapter 1
	R	Mar 29	2	Spatial organization	Chapter 1
2	T	Apr 3	3	Selected economic aspects	Chapter 2
	R	Apr 5	4	Selected economic aspects	Chapter 2, 7
3	T	Apr 10	5	Spatial interaction (Ex. 1)	Chapter 7
	R	Apr 12	6	Spatial interaction	Chapter 7
4	T	Apr 17	7	Spatial interaction	Ch. 7, 11*
	R	Apr 19	8	Spatial interaction (Ex. 1 due)	Chapter 11*
5	**T**	**Apr 24**	**9**	**EXAM #1**	
	R	Apr 26	10	Networks (Ex. 2)	Chapter 9
6	T	May 1	11	Networks	Chapter 9
	R	May 3	12	Networks	Chapter 9
7	T	May 8	13	Allocation (Ex. 2 due)	Ch. 13*, 10
	R	May 10	14	Allocation	Chapter 10
8	T	May 15	15	Allocation	Chapter 10
	R	May 17	16	Allocation	Chapter 10
9	T	May 22	17	Urban Transportation	Chapter 6
	R	May 24	18	Urban Transportation	Chapter 8
10	T	May 29	19	Urban Transportation	Chapter 12*

	R	**May 31**	**20**	**EXAM #2**	

Chapters with an "*" represent more advanced material which will be covered in an introductory manner depending on the availability of time. A non-credit practice exercise is planned for the allocation section.

GEOG 647: Locational Analysis

Winter 2009

Instructor

Kamyoung Kim Office: 0126
Phone: 292-8232 Email: kim.1820@osu.edu Office Hours: Monday 3-5 pm, Wednesday 3-5 pm, or by appointment

Lecture Time and Location

Monday and Wednesday 1:30-2:48 pm 0155D Derby Hall **Lab** Friday 8:30-10:18 pm (Call #09854-3) 0140 Derby Hall

Course Description and Objectives

This course provides a technical overview of location theory in the context of GIScience. Geographic issues will be addressed to highlight practical relevance of location analysis. Utilization and implementation considerations using GIS will be explored.

Credit Hours

This course is five credit hours (graduate and undergraduate) consisting of two 90 minute lectures and one two hour laboratory each week.

Prerequisites

At the moment, there are no prerequisites per se. However, Geog 607 (Introduction to GIS) and Bus 331 (Introduction to Operations Research), or equivalent, is recommended.

Course Evaluation

1. **Examinations** (60% of class grade) – There will be a mid-term and a final examination for this course. Exams will be given on the following dates:

   Midterm exam: Monday February 5, 2007 (25%)
   Final exam: Tuesday March 13, 2007 (35%) at 1:30-3:18 pm

2. **Laboratory exercises** (20% of class grade) – Weekly lab assignments will be given and collected corresponding to topics covered in class. The laboratory exercises will require the use of ArcGIS and LINGO.

3. **Reviews** (10% of class grade) – Three (3) one-page reviews of recent journal articles related to weekly topics is required.

4. **Quizzes**, exercises and class participation (10% of class grade) – Throughout the quarter, quizzes and other assignments will be given as a component of class participation. Attendance and participation in class discussion is expected of all students.

Course Syllabus

Tentative lecture topics, reading schedule and due dates:

Week	Dates	Topic(s)
1	Jan. 3	Introduction
2	Jan. 8 & 10	GIS fundamentals Model building fundamentals
3	Jan. 15 & 17	**MLK Day – no class (Monday)** Analyzing facility systems
4	Jan. 22 & 24	Suitability analysis Site selection I
5	Jan. 29 & 31	Site selection II Corridor siting
6	Feb. 5 & 7	**Midterm** Area selection
7	Feb. 12 & 14	Standards modeling
8	Feb. 19 & 21	Dispersion modeling
9	Feb. 26 & 28	Allocation modeling
10	Mar. 5 & 7	Review
Final	**3/13/2007**	**1:30 – 3:18 pm (0155D Derby Hall)**

Additional material and updates may be found on the class web page at:

https://carmen.osu.edu/

Readings

Weekly reading materials (book chapters and journal articles) will be made available no later than one week prior to lecture. All reading material may be obtained from the instructor. Additional reference and reading materials may be assigned during the quarter.

Academic Misconduct

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GEOG 655: Land Use Geography

Instructor

Professor Darla Munroe

Email: munroe.9@osu.edu

Office: 1123 Derby Hall

Phone: 247-8382

Office Hours: TBD

Meeting times

1116 Derby Hall, MW 1:00-2:48pm

Course Website

https://carmen.osu.edu, check this website for lecture notes, lab assignments, readings, and announcements.

Prerequisites

Geog 240 or permission of instructor.

Credit Hours

This class is for 5 credits.

Course Description

What are the causes and consequences of recent land-use changes? Within North America, phenomena like urban decentralization, forest regeneration, agricultural intensification and movement from Ohio to the Sunbelt all have implications for the physical layout of the land, which in turn has both environmental and social implications.

Land use, or the human modification of the physical environment, is a primary topic of interest to geographers. In this course, we will review recent major land-use changes in North America and connect these changes to recent trends in the economy. Thus, we will analyze how larger-scale processes lead to local land-use changes. Finally, we will examine two instances of shifting relationships between natural areas (i.e., the Great Lakes and forests) and land use.

Required Readings

- A coursepack of recent articles from the geography literature concerning land use will be the primary readings for this course.

Grading Policy

Final course grades will be based on the following weighting of assessment components:

Class participation and comments on weekly readings	30%
4 Homework assignments	20%
Final project	50%

Final course grades will be assigned based on the following grading scale:

Grading Scale

Percentage	Letter Grade	Qualitative Description
93-100	A	Achievement that is outstanding relative to the level necessary to meet course requirements.
90-92.9	A-	
87-89.9	B+	Achievement that is significantly above the level necessary to meet course requirements.
83-86.9	B	
80-82.9	B-	
77-79.9	C+	Achievement that is in keeping with the course requirements in every respect.
73-76.9	C	
70-72.9	C-	
67-69.9	D+	Achievement that is worthy of credit even though it fails to meet fully the course requirements.
60-66.9	D	
0-59.9	E	Work that was either completed but not worthy of credit, or incomplete.

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procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-847). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu /info_for_students/csc.asp).

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Course Schedule

Week	Topic	Lab
1	Introduction to the course	
	Changing urban regions	
2	Trends in metropolitan population	
3	Transportation	
4	Micropolitan areas and exurbanization	
	Economic shifts	
5	The information economy	
6	Deindustrialization	
7	Extractive industries	

	From resource regions to amenity-led growth	
8	Case study: land-use change along Lake Erie	
9	Case study: forest regeneration in Southeast Ohio	Project
10	Project presentation	

Note: this schedule is subject to change. Please check the class website on Carmen frequently for updates.

GEOG 680: Computer Cartography and Geographical Visualization

Instructor

Ola Ahlqvist, ahlqvist.1@osu.edu

Office phone: 247-7997
Office address: 1049 Derby Hall, 154 N Oval Mall
Office hours: Thursdays 9-11 AM, or by appointment, or drop-in (my door is always open when I am in but I reserve the right to be busy)

Course Description

This course further explores issues and techniques surrounding computer based mapping and visualization. We take a deeper look into data structures and data transformations as a basis for different analytical techniques and visual representations. We also explore techniques for mapping multidimensional data. Participants will get hands-on experience of transforming and preparing spatial data for exploration, visualization, and interactive mapping.

Text

Slocum, T.A. et al., 2005, Thematic Cartography and Geographic Visualization, 2nd or 3rd ed., Upper Saddle River, NJ : Pearson/Prentice Hall, 518p.

There should be plenty of used 2nd eds. The new 3rd ed. is soon to be released.

Coursepack including the following texts:

Demers, M.D., 2005, *Fundamentals of Geographic Information Systems*, 3rd Ed., Wiley, Chapter 4 – GIS data models, pp. 72-109

Longley, P.A., Goodchild, M.F., Maguire, D.J., and Rhind, D.W., 2005, *Geographic Information Systems and Science,* 2nd Ed., Wiley, Chapter 6 – Uncertainty, pp.127-153.

Chrisman, N., 2002, *Exploring geographic information systems*, 2nd Ed., Wiley, Chapter 4 – Attribute-based operations & Chapter 9 – Transformations, pp. 105-118 & 217-242.

Dent, B.D., 1999, *Cartography – Thematic map design*, 5th Ed., McGraw Hill,

Chapter 11 – The Cartogram: Value-by-area mapping, pp.207-220.

Additional readings made available online:

Buckley, A. (2003). Atlas mapping in the 21st century. *Cartography and Geographic Information Science*, 30(2), 149-159.

Harrower, M. (2004). A look at the history and future of animated maps. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 39(3), 33-42.

Holt, J. B., Lo, C. P., & Hodler, T. W. (2004). Dasymetric estimation of population density and areal interpolation of census data. *Cartography and Geographic Information Science*, 31(2), 103-121.

Mennis, J. (2003). Generating surface models of population using dasymetric mapping. *Professional Geographer*, 55(1), 31-42.

Tobler, W. (2000). The development of analytical cartography: A personal note. *Cartography and Geographic Information Science*, 27(3), 189-194

Recommended:

The New York Times, or other newspaper with good print AND online maps and graphics in their coverage of current events.

You will be asked to present to the class and discuss the design of one map on a current event. This activity will be ongoing throughout the quarter. Free copies of NYT are available to students in the residence halls and student discounted personal subscriptions run ~$20 for the quarter.

Schedule

The most up to date schedule will always be posted on Carmen under Course info. Any significant changes to the schedule will be announced well in advance.

Lectures

Tuesdays and Thursdays 12:30 PM — 2:18 PM in 0140 Derby Hall.

Class material such as lecture notes, worksheets, handouts will be made available through Carmen under the heading Lectures.

During lectures we will often spend some time to work with sample problems and discuss practical applications. These activities are meant to build a deeper

understanding of the subject matter but it also relies heavily on your active participation. You will also sometimes have work to prepare before classes or other types of homework assignments.

Labs

Lab time follows directly after lecture **Tuesdays and Thursdays 2:30 PM — 3:18 PM**. Details on the labs will be posted on Carmen under the Labs heading.

You will be provided with a software CD containing a one-year time-out ArcView 9.2 and extensions license. Please be advised that you should review the following site before installing the software:
http://www.esri.com/industries/university/education/student_faqs.html

Please also note that as you register the software, you should make sure to write out our full school name "The Ohio State University" in the organization field rather than using any acronyms. Furthermore, avoid using the word "Student", or the word "Self" or any initials since this will cause a delay in the registration time (this requires that ESRI manually review the registration rather than having the process be completed automatically).

Grading Policy

Overall credits for the course will be given approximately as follows:

Lab Assignments	65 %
In-class work & Homework	10 %
Project	25 %

The credits given to each course component reflects my notion that I can only facilitate for you to acquire theoretical and practical knowledge. *Only you can learn* what we want you to. Consequently, assessments relate mainly to your own learning, such as demonstrating practical use of the covered topic matter in lab, homework and an individual project.

Final letter grades will be assigned based on how many percent of total points available you have earned.

92.5 <= A
90.0 <= A- < 92.4
87.5 <= B+ < 89.9
82.5 <= B < 87.4
80.0 <= B- < 82.4
77.5 <= C+ < 79.9
70.0 <= C < 77.4
60.0 <= D < 69.9
F < 60

Examination Policy

There will be a continuous evaluation through lab, homework and in-class assignments. In addition the final project will contribute to about 1/4 of the total grade.

All course work (labs, homework, individual project work) are expected by the due date. A late penalty of at least 10 percentage units will be taken off each day after the due date.

If you have a genuine reason (known medical condition, a pile-up of due assignments on other courses, ROTC, athletics teams, job interview, religious obligations etc.) for being unable to complete work on time, then some flexibility is possible. However, if in my judgment you could reasonably have let me know *beforehand* that there would likely be a delay, then a late penalty will still be imposed if I don't hear from you until *after* the deadline has passed. For unforeseeable problems, I can be more flexible.

If there are ongoing medical, personal, or other issues that are likely to affect your work all semester, then please arrange to see me to discuss the situation.

Lab Assignments: You are welcome to discuss the labs amongst yourselves, in fact this is encouraged, but the final product you hand in *must be your own work* (see Academic Integrity Policy below). Details of the lab assignments will be posted on the course web site.

In-class work & Homework: Some classes have time allotted for discussions, in-class work and other activities. Your contribution in these and in class generally, will be noted, and used to determine part of your final grade, just showing up won't count a whole lot toward this component! Obviously, you will receive no credit for in-class work if you are not present.

During the quarter, there will be several homework assignments. The main purpose of the homework is to provide an opportunity to learn how to apply the things we cover during the lectures. Homework will be assigned during class, and usually due by the next class period. If you are having difficulty with assignments you should get help, whether from fellow students, from the course TA, or from me. Whatever you do, ask someone!

Exam: In addition there will be four smaller exams. These exams will be given in class, will cover material from the lectures and assignments, and will consist of multiple choice, short answer, and problem solving questions. There will be no final exam; instead an individual project will assess your ability to apply what you have learned in a practical situation.

Term project: As an individual project you will produce a map of a topic that you choose. Many students take this as an opportunity to map out some aspect of their favorite hobby or interest. In this project you will go through the entire map-making process; from ideation, through data collection and design, to a final product. Further details of the individual project will be posted on Carmen.

There will be no make-up exams or labs except for *documented* medical or family emergencies.

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Geography 683: Introduction to Geographic Analysis
Autumn 2008

Instructor Desheng Liu (liu.738@osu.edu)
Office 1189 Derby Hall, 247-2775
Office Hours M 4:00-5:00pm, W 11:00-12:00pm, or by appointment

Teaching Assistant Guoxiang Ding (ding.45@osu.edu)
Office 1083 Derby Hall, 688-3936
Office Hours F 12:30-2:00pm, or by appointment

Lectures 1080 Derby Hall, Monday and Wednesday 2:30-3:48pm

Labs 0140 Derby Hall, Friday 10:30-12:18pm or 2:30-4:18pm

Course Website http://carmen.osu.edu

Required Texts

[R] Rogerson, P.A. (2006). *Statistical Methods for Geography: A Student's Guide (Second Edition)*, Sage Publications, London. (ISBN 1-4129-0796-9).

Norusis, M.J. (2006). *SPSS 14.0 Guide to Data Analysis*, Prentice Hall, New Jersey. (ISBN 0-13-199528-6).

Supplementary Texts

Burt, J.E. and Barber, G.M. (1996). *Elementary Statistics for Geographers (Second Edition)*, The Guilford Press, New York. (ISBN 0-89862-999-3).

Mitchell, A. (2005). *The ESRI Guide to GIS Analysis - Volume 2: Spatial Measurements & Statistics*, ESRI Press, Redlands. (ISBN 978-1-58948-116-9).

Course Description and Objectives

This course will provide an introduction to fundamental methods used in quantitative geographic research. The emphasis will be on the statistical analysis of geographic data. The objectives are

1) to introduce students a range of fundamental quantitative approaches in geographic problem solving, 2) to present students real-world examples from a variety of topical areas in geography, and 3) to provide students a basis for understanding more advanced geographic data analysis methods.

Prerequisites

Statistics 145 or 245, or equivalent, or graduate standing in geography, or permission of the instructor.

Grading Policy

Your final course grade will be based on the following weighting of assessment components:

Class exercises and quizzes	15%
Homework	10%
Labs	25%
Midterm Exam	20%
Final Exam	30%

- Class exercises and quizzes will be frequently given as an important component of class participation. Absolutely no make-ups will be given.
- All assignments should be turned in on time. Late submissions will NOT be accepted.
- Students must take all examinations to receive credits. No make-up exams will be given unless legitimate documents for medical or personal emergency are presented **prior to** the examinations.

Final course grades will be assigned based on the following grading scale:

A: 93–100 | **A-**: 90–92 | **B+**: 87–89 | **B**: 83–86 | **B-**: 80–82 | **C+**: 77–79
C: 73–76 | **C-**: 70–72 | **D+**: 67–69 | **D**: 60–66 | **F**: below 60

Student Responsibility

You are responsible for your own learning. I am here solely to facilitate your learning and understanding of the course materials. I will help you as much as I can, but learning the materials is ultimately up to you. This includes:

- attending class meetings or getting assignments and notes from others if you miss class;
- asking questions when you have them, either in class or out of class;
- doing the assigned homework on time and participating in class;
- contacting me if you have difficulties.

Calculators

A calculator (with statistical functions) may be used for homework and exams. No cell phone calculators will be allowed during exams. (Note: This also applies to PDAs with calculator and/or communication functions.)

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-847). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Cell Phones

Cell phones must be either turned off or put on vibrate during class, as cell phones ringing during class disrupt the learning process. Additionally, no cell phone calculators will be allowed on any exams in the course. (Note: This applies also to PDAs with communication capabilities.)

E-mail

In order to protect your privacy, all course e-mail correspondence must be done through a valid OSU name.number account. If you have not activated your OSU email account, you can activate your account at https://acctmgt.service.ohio-state.edu/cgi-in/KRB1EntryAdd.

Disability Services

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD292-0901; http://www.ods.ohio-state.edu/.

Course Policy on Unpaid Fees and Students Not Registered

If your fees are unpaid or if you are not officially registered for the course, you should not be attending class. Students with unpaid fees at the time of the first exam need to talk to me as soon as possible in order to continue their attendance. Students who are not registered in the course need to work out their registration issues in order to continue their attendance.

Receiving an 'I' for the Course

You cannot receive an incomplete for the course unless 70% of the work in the course has been completed. Extenuating circumstances will be handled on a case-by-case basis.

Tentative Course Schedule

We	Date	Topics	Readings	Labs	
1	09/19	Introduction	[R] 1	No lab	
2	09/24	Basic terms and notations	[R] Appendix B, C	Lab1	
	09/26	Geographic data			[R] 2.1
3	10/01	Special issues of geographic data	[R] 1.7	Lab 2	
	10/03	Descriptive statistics			[R] 2
4	10/08	Geospatial information techniques		Lab 3	
	10/10	Probability (I)			[R] 3
5	10/15	Probability (II)	[R] 4	Lab 4	
	10/17	Sampling			[R] 5.7
6	10/22	**Midterm Exam: 2:30 – 3:48 PM**		Lab 5	
	10/24	Estimation			[R] 5.1~5.2
7	10/29	Hypothesis testing (I)	[R] 5.3~5.6	Lab 6	
	10/31				Hypothesis testing (II)
8	11/05	Analysis of Variance	[R] 6	Lab 7	
	11/07	Correlation			[R] 7
9	11/12	No class (Veterans' Day)		Lab 8	
	11/14	Regression (I)			[R] 8
10	11/19	Regression (II)	[R] 9	No lab	
	11/21	Spatial autocorrelation			[R] 10.3.2
11	11/26	Spatial pattern analysis	[R] 10		
	11/28	Review			
12	12/06	**Final Exam: 11:30 – 1:18 PM**			

GEOG 684: Geographic Applications of Remote Sensing

Instructor

Professor Desheng Liu

Email: liu.738@osu.edu

Office: 1189 Derby Hall

Phone: 247-2775

Office Hours: TBD

Lectures

1116 Derby Hall, Wednesday 10:00-11:48pm

Labs

0140 Derby Hall, Wednesday 3:30-5:18pm

Course Website

https://carmen.osu.edu, check this website for lecture notes, lab assignments, readings, and announcements.

Prerequisites

Statistics 245 or permission of instructor

Credit Hours

This class is for 5 credits.

Course Description

Remote sensing has been widely used in various geographic researches including climate change, water resources, land use and land cover change, forest management etc. This course provides an introduction to the use of remote sensing in geographic problem solving. Main topics to be covered include remote sensing principles, image enhancement, image classification, change detection, and accuracy assessment. Real-world examples from a variety

of topical areas in geography will be used to illustrate the geographic applications of remote sensing. Computer laboratory exercises are designed to help students to gain hands-on experiences on the digital processing of remotely sensed data. Students are also expected to complete a project that applies remote sensing techniques to solve a geographic problem.

Required Textbook

- Jensen, John R., 2005, *Introductory Digital Image Processing: A Remote Sensing Perspective*, Prentice Hall: Upper Saddle River, NJ, 3rd ed. ISBN 0-13-145361-0

Optional References

- Jensen, John R., 2007, *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall: Upper Saddle River, NJ. 2nd ed. ISBN 0-13-188950-8
- Gong, Peng, 1997, *Remote Sensing and Image Analysis*, unpublished book, available at http://www.cnr.berkeley.edu/~gong/textbook/

Grading Policy

Final course grades will be based on the following weighting of assessment components:

Class participation	15%
Lab exercises	35%
Final project	50%

Final course grades will be assigned based on the following grading scale:

A: 93–100 | **A-**: 90–92 | **B+**: 87–89 | **B**: 83–86 | **B-**: 80–82 | **C+**: 77–79

C: 73–76 | **C-**: 70–72 | **D+**: 67–69 | **D**: 60–66 | **F**: below 60

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Course Schedule

Week	Topic	Lab
1	Introduction to remote sensing	Lab 1
2	Image calibration: radiometric correction	Lab 2
3	Image calibration: geometric correction	Lab 3
4	Image enhancement: spectral transformations	Lab 4
5	Image enhancement: spatial transformations	Lab 5
6	Image classification: unsupervised approaches	Lab 6
7	Image classification: supervised approaches	Lab 7

8	Change detection	Project
9	Case studies	Project
10	Project presentation	

Note: this schedule is tentative and subject to change. Please check the class website on Carmen frequently for updates.

GEOG 685: Intermediate Geographic Information Systems

Instructor

Professor Darla Munroe
Office: 1123 Derby Hall
Phone: 247-8382
Email: munroe.9@osu.edu
Office Hours: Tue 1-3pm; Wed 10-12pm

Teaching Assistant

Guoxiang Ding
Office: 1155 Derby Hall
Phone: 292-2704
Email: ding.45@osu.edu
Office Hours: Tue 12:00-3:00 pm

Course Description and Objectives

This course has three major goals: (1) to introduce students to the implementation of spatial analysis approaches within the context of GIS technology; (2) to provide students with a sound basis for understanding the operational functionality of modern GIS technology; and (3) to apply spatial reasoning in solving geographic problems.

Prerequisites

Geography 607, or equivalent, or permission of the instructor. Permission to take this course may be granted based upon GIS courses taken elsewhere.

Lecture Time and Location	Lab
Tuesday and Thursday 10:30-11:48 am 1080 Derby Hall	Tuesday 3:00-4:48 pm OR Thurs 3:00-4:48 pm 0140 Derby Hall User name: G685, password: G685WI07

Required Text

Chor Pang Lo and Albert K.W. Yeung (2007). *Concepts and Techniques of Geographic Information Systems*, 2nd ed. (Prentice Hall). ISBN 013149502X (New ISBN 9780131495029).

This book has a companion website with instructional materials:
http://www.prenhallgeo.com/Lo/

Optional Materials

Getting to know ArcGIS Desktop. ESRI Publications. This book comes with a 90-day limited version of ArcGIS.

Course Website via Carmen
http://telr.osu.edu/carmen (For help, contact: carmen@osu.edu)

Course Evaluation
1. Examination (25% of class grade) - There will be a mid-term examination for this course. The exam will be given on the following date during the regularly scheduled lecture time. Midterm exam: Thursday, February 15, 2006

2. Laboratory exercises (30% of class grade; 5% each) - Weekly lab assignments will be given and collected corresponding to topics covered in class. The laboratory exercises will require the use of ArcGIS and associated spatial information.

3. Article review (10% of class grade) – Students will sign up to read one of 8 recent articles in GIS. Students will summarize the GIS application or issue, the techniques used as they relate to class discussions and exercises, and provide a critique of the article. The review will be due at the beginning of class (10:30 am) on Thursday, March 1, 2007.

4. Final project (25% of class grade) – Students will work in teams of no more than four to develop a class project over the course of the quarter. Teams will include at least one graduate student and one undergraduate. Teams will make an in-class presentation and turn in a 15-page write-up. Assessment will be based on both a group grade, and individual grade (determined in part by peer review).

5. Participation (10% of class grade) – Each week there will be one in-class activity relevant to the material covered that week. Students will receive credit for participating in that activity. Students will also receive credit for answering the questions of others on the Discussion Board in Carmen.

Grading
Grades will be assigned following the OSU standard grading scheme:

Percentage	Letter Grade	Qualitative Description
93-100	A	Achievement that is outstanding relative to the level necessary to meet course requirements.
90-92	A-	
87-89	B+	Achievement that is significantly above the level necessary to meet course requirements.
83-86	B	
80-82	B-	
77-79	C+	Achievement that is in keeping with the course requirements in every respect.
73-76	C	
70-72	C-	

67-69	D+	Achievement that is worthy of credit even though it fails to meet fully the course requirements.
60-66	D	
0-59	E	Work that was either completed but not worthy of credit, or incomplete.

Policies

Course material: Students are responsible for all material presented in class, all assigned readings, and all material presented during lab sessions. **A summary of the lecture material for each class will be posted on Carmen, but is not meant as a substitute for attending class.** Students are expected to attend all lectures, complete the required reading, take the exam on the scheduled date, and participate in a final presentation of their group project. Students are also expected to take a proactive role by seeking assistance from the TA or the instructor when problems arise.

Attendance: **Attendance of lab sessions is required**. Students must attend the lab for which they are registered. Access to data and instructions for the lab exercises are distributed during lab sessions.

Late Papers: Assignments are due on the dates indicated on the syllabus. Lab exercises should be handed in during the student's next laboratory session (with the exception of labs 1 and 6, which should be handed in during lecture). **Students must be present to turn in labs**; labs cannot be left in my mailbox. Although group discussion of assignments is encouraged, all materials submitted by a student must be their original work; group submissions are not allowed. Submissions of substantially similar work by more than one student will be dealt with as acts of scholastic dishonesty.

Penalties for lateness will be assessed as follows:

Date	**Penalty**	**Example**
On the due date, but after lab session	1/3 letter grade	A becomes A-
One day late	1 letter grade	A becomes B
Two days late	2 letter grades	A becomes C
More than two days late	No credit	A becomes E

Students who miss class due to serious illness or other extreme circumstances must submit documentation to me within one week of the absence in order to turn in any work missed. If documentation is not received within this period excusing the absence, the student will receive a 0 (zero) grade for any work missed.

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Course Syllabus

Lecture topics, reading schedule and due dates. May be subject to change, see CARMEN.

Week	Date	Day	Topic	Reading	Lab	Due
1	4-Jan	Th	Introduction	Ch 1	No Lab	
2	9-Jan	Tue	Spatial referencing	Ch 2	#1: Data integration	
	11-Jan	Th				
3	16-Jan	Tue	Digital representation	Ch 3	#2: Using ModelBuilder	Lab 1
	18-Jan	Th	Geovisualization	Ch 7		
4	23-Jan	Tue	Data quality	Ch 4	#3: Crime Scene Investigator	Lab 2 Project proposal*
	25-Jan	Th	Raster data model	Ch 5		
5	30-Jan	Tue	Vector data model	Ch 6	#4: Vector problem-solving	Lab 3
	1-Feb	Th				
6	6-Feb	Tue	Spatial analysis	Ch 10	#5: 3D visualization and analysis	
	8-Feb	Th	Terrain modeling	Ch 9		
7	13-Feb	Tue	Review		No Lab	Lab 4
	15-Feb	**Th**	**Midterm exam**			
8	20-Feb	Tue	GIS within IT	Ch 11	#6: GeoDatabase design	Lab 5
	22-Feb	Th				
9	27-Feb	Tue	GIS issues and prospects	Ch 12	No Lab	Lab 6* Article review*
	1-Mar	Th				
10	**6-Mar**	**Tue**	**Final projects**		No Lab	
	8-Mar	**Th**	**Final projects**			
	14-Mar	**Tue**	**Final project report due**			Report due by 5 pm

* The project proposal, Lab 6, the Article review and the Final project report are to be handed in at the beginning of lecture. Labs 1, 2, 3, 4 and 5 are to be handed in during the student's assigned lab time.

Geog 686: GIS Applications in Social Science and Business
Spring 2009

Instructor:
Dr. Mei-Po Kwan
Office: Room 1054, Derby Hall
Phone No: 292-9465
E-Mail: *kwan.8@osu.edu*
Office hours: By appointment

Time: Tuesday and Thursday 1:30 - 2:48PM in DB 0140

Lab Session Time: Monday 1:00 PM – 2:48 PM or
Wednesday 1:00 PM– 2:48 PM in DB 0140

GTA:
Mr. Guoxiang Ding
Office: 1155 Derby Hall
Phone No: 292-2704
E-Mail: *ding.45@osu.edu*
Office hours: Monday, Wednesday 12:00 PM – 1:00 PM or by appointment

Course objective

The objective of this course is to apply GIS techniques on social science and business research. More specifically the goals are: (1) to provide students with an understanding of how GIS can be applied in social science and business research; (2) to familiarize students with advanced GIS and modeling techniques; (3) to provide students with hands-on experience in working with various data sources through a project related to their own research interest.

Format of the course

This course will rely heavily on both lecture and reading and discussing the literature on applications of GIS. Students will also be asked to gain hands-on experience in GIS applications by attending lab sessions, working on lab assignments and a major project related to their own area of interest. For the project, students will have to define their research/application problem, explain how modeling and GIS techniques are used and produce output from the results of the project. Students will have flexibility in defining the application area and choosing software for their application.

Course readings

Required readings for this class are also from a variety of journal articles and GIS magazines. They will be kept in Carmen. Students are required to obtain the readings. The following optional materials will also be helpful for this class and lab exercises.

(1) Environmental Systems Research Institute, Inc., 1999. *Transportation GIS.*

(2) Environmental Systems Research Institute, Inc., 2000.*GIS for Health Organization.*

(3) Grant Ian Thrall, 2002. Business Geography and New Real Estate Market Analysis. Oxford University Press.

(4) Environmental Systems Research Institute, Inc., 2004. *Getting to know ArcGIS.*

(5) Environmental Systems Research Institute, Inc., 2003. *Advanced Spatial Analysis*

(6) Wang, F. 2006. *Quantitative Methods and Applications in GIS.* London: CRC Press

Course requirements and prerequisites

Geog 607 and Geog 685 are the prerequisites for the class, or permission by the instructor. The distribution of your grade is as follows:

25% Mid-Term examination
15 % Class participation
30% Laboratory exercises
30% Class project

Class Participation and Lab Assignments

Students are expected to actively participate in classes and lab sessions. Above half of the class sessions will be lectures and the rest will be devoted to discussions of GIS applications. Students are expected to read the required materials before class and participate in discussion. There will also be presentations by GIS practitioners from private organizations such as Nationwide Insurance. Students are required to attend these presentations.

We will be using mainly ArcGIS in the labs.

For lab assignments, there will be a **5%** penalty per day if late. Work handed in more than **2-days** late will **NOT** be accepted. Unless specified, labs are due one week from when they are introduced and are due by the end of the students' enrolled lab session – any labs turned in after the end of class will be considered late.

Academic Misconduct

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cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-847). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Disability Services:

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Examination and Class project:

There is a mid-term examination to be held about the later part of the quarter. There is no final examination in this course. Part of the evaluation (30%) will be based on a class project. Students are required to formulate a project through defining an application or research problem and carrying out analysis using GIS techniques.

You can work on an individual project. You are also welcome to work in teams (1-2 students in one project usually). Students can also use software other than the ones introduced in the lab exercises such as TRANSCAD, etc.

A project proposal (1-2 pages) is due on April 17 (Tuesday). The proposal should include the name(s) of the student(s) involved, the problem to be solved, and different data sets, techniques and software to be used. A written report is required.

Spring 2007 Course Schedule*

	Tuesday	Thursday	Lab Sessions
Week 1 Mar 27 and 29	Introduction: GIS applications	Application issues: Scale	**Lab1:** Introduction to ArcGIS, GIS Tutorial, Resources and Techniques

Week 2 April 3 and 5	GIS applications In Transportation	Location Allocation Models (Dr. Ningchuan Xiao)	**Lab2:** Spatial Interaction Models
Week 3 April 10 and 12	GIS applications In Transportation	GPS	**Lab3:** Processing GPS Data
Week 4 April 17 and 19	GIS Application by Practitioner (Ohio Department of Transportation)	GIS Application by Practitioner (Nationwide Insurance)	**Lab4:** Measuring Spatial Accessibility to Primary Care Physicians
Week 5 April 24 and 26	GIS Application on Health Issues I	GIS Applications on Health Issues II	**Lab5:** Disease Mapping and Analysis Program (DMAP)
Week 6 May 1	GIS Application on Urban Issues I	GIS Application on Urban Issues II	**Lab6:** Spatial Analysis of Homicide Patterns
Week 7 May 8 and 10	GIS and Spatial Analysis of Market: Customer targeting and geodemographics approach	GIS Applications on Sale forecasting and Store-assessment	**Lab7:** Site Selection Using ArcGIS
Week 8 May 15 and 17	**Mid Term Exam May 15**	Class Project	Class Project
Week 9 May 22 and 24	Class Project Presentations	Class Project Presentations	Class Project
Week 10 May29 and May 31	Class Project Presentations	Class Project Presentations	Class Project
Final Exam week	-		

* Due to uncertainty in scheduling of GIS practitioners, this weekly schedule is tentative and subject to change. Check the course web site for the most updated schedule.

GEOG 687: GIS Design and Implementation

The Ohio State University

Autumn 2008

Location: 1116 Derby Hall (Lecture), 0140 Derby Hall (Lab) Time: MW 12:30 - 1:48 PM (Lecture), F 12:30 - 2:18 PM (Lab) Course URL: http://carmen.osu.edu

Instructor: Professor Ningchuan Xiao Office: 1132 Derby Hall Phone: 292-4072 E-mail: xiao.37@osu.edu Office Hours: Friday 2:30-4:00 PM or by appointment

This course concentrates on the design and implementation techniques that are widely used for developing today's geographical information systems and other computer programs for spatial analysis. Major topics of this class include project management, requirement analysis, spatial database design, object-oriented analysis and design, unified modeling language, and system verification and validation. Students will learn the GIS development skills using different programming languages through weekly lab exercises and group projects that address "real-world" GIS application problems.

Goals

The topics covered in this course are selected to achieve the following goals:

- Understanding the design and implementation issues in GIS development
- Mastering basic software development techniques, especially those using object-oriented approaches
- Understanding spatial database design techniques
- Developing personal experience of GIS development through hands-on labs and projects
- Understanding ethical issues in GIS

Texts

The following two books will be used for the lecture and labs:

- Yeung, A.K.W. and Hall, G.B. 2007. *Spatial Database Systems: Design, Implementation and Project Management*, Springer.
- Schmuller, J. 2004, *SAMS Teach Yourself UML in 24 Hours*, 3rd Ed. SAMS Publishing.
- R. Burke, 2003, *Getting to Know ArcObjects: Programming ArcGIS with VBA*, ESRI Press.

The lecture does not necessarily follow the textbooks. Instead, I will use my own lecture notes, which will be made available on the course schedule web site. Therefore, it is important for

students who take Geog 687 are expected to attend each class and participate in discussion and exercises. Further readings, when applicable, will be handed out during the class.

Prerequisites

Geography 685 or consent of instructor.

Credit Hours

This class is for 5 credits.

Evaluation

Student performance is assessed by the following five components:

• Labs (25%). Hands-on approaches will be used. Nine weekly lab assignments are based on the book *Getting to Know ArcObjects* and supplementary materials. More details are described in the Lab Syllabus.

• Group Project (25%). Students attending this class will be divided into several groups, each working with a "client" on a GIS development project. Members of each group will determine necessary working teams to fulfill a particular design and implementation goal of the project. The projects should be concluded by (a) delivering the final products including a full set of documentations to the clients, and (b) professionally presenting the project to the clients and the class. During the quarter, a number of formal presentations will be made by each group to the class to report the progress. The performance of each group and its members will be reviewed by peers (groups and individuals), their clients, and the instructor. Detailed review instruction and forms will be handed out.

• Examination (20%). A comprehensive examination will be given.

• Homework (15%). There will be two homework assignments. A homework assignment is normally due in one week after it is handed out.

• Case studies (10%). In addition to attending the lecture, students should also play an active role in group studies. A number of groups will be created during the second week. Each group will choose (or be assigned) some GIS applications and additional reading materials. Groups should thoroughly study these materials and professionally present them to the class. The performance of each student will be evaluated by the peers and the instructor.

• Participation (5%). Attendance and participation in class discussion are expected of all students.

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Schedule

The **schedule** will be updated whenever new materials become available.

* The guest lecture on 10/10 is from 1:30 to 2:18 PM.

Week	Date	Section	Lecture	Activity	Labs (F 12:30-2:18)
1	9/19	**Overview**	Introduction		9/21 Customization
2	9/24		Requirements	Group formation	
	9/26		Guest speaker		9/27 VBA Programming
3	10/1		Project management		
	10/3	**Design**	What is design?	Briefing	10/5 Knowing the objects
4	10/8		UML: object orientation		
	10/10		Guest speaker *		10/12 Tools & commands
5	10/15		UML: use cases		
	10/17		UML: diagrams	Project progress / GE	10/19 Geodatabases
6	10/22		UML: applications		
	10/24		Database: ER model	Homework 1	10/26 Symbology & feature
7	10/29		Database: relational model		
	10/31		Web-based GIS	Project progress / GE	11/2 Dynamics & tables
8	11/5	**Implementation**	Verification and validation		
	11/7		Guest speaker	Homework 2	11/9 Web GIS: basics
9	11/12		No class (Veteran's Day)		
	11/14		Software testing	Project progress / GE	11/16 Web GIS: Google maps
10	11/19		Case Study		
	11/21		Case Study		11/23 No lab (Thanksgiving)
11	11/26	**Examination**			
	11/28			Presentations / GGE, CE	11/30 Web GIS: databases

GEOG 688: Emerging topics in GIS: Web-Based GIS

Location: 1116 Derby Hall (Lecture), 0140 Derby Hall (Lab)
Time: M 8:30 - 10:18 AM (Lecture), M 4:30 - 6:18 PM (Lab)
Course URL: http://carmen.osu.edu

Instructor: Professor Ningchuan Xiao
Office: 1132 Derby Hall
Phone: 292-4072
E-mail: xiao.37@osu.edu

The Internet has fundamentally changed the way of computing. The combination of geographical information technologies and the Web can be observed in numerous applications such as daily travel planning and complicated natural resource management. The major goal of this course is to help students understand the design and implementation of web-based GIS for different purposes. We will survey a variety of enabling web-based techniques for spatial data management, geographical knowledge representation, and mapping. A wide range of web-based GIS applications will be discussed. This course also includes a hands-on lab exercises. After taking this class, students establish a broad understanding of web-based GIS and will be able to create GIS applications using various techniques.

Text and readings

A suite of reading materials will be provided during the quarter and students are required to finish each week's reading assignment and submit an abstract before the class starts. Part of the lecture will be from the following book: *Internet GIS*, (by Peng, Z.-R. and Tsou, M.-H., 2003, John Wiley & Sons, Inc). The lecture does not necessarily follow the textbook. Instead, I will use my own lecture notes, which will be made available on the course schedule web site.

Prerequisites

Geography 686 or 687 or consent of instructor is required. Students should have a good understanding of geospatial data.

Credit Hours

This class is for 5 credits.

Evaluation

Student performance is assessed based on the following four main components:

- **Labs (30%)**. Hands-on approaches will be used for weekly lab assignments. The labs are not based on a specific textbook. I will provide detailed lab instructions before each week's lab; many lab instructions and assignments are based on a variety of Internet sources.
- **Projects (30%)**. Each student will work in a group of no more than 3 members. The group will complete an appropriate project using (some of) the techniques learned in this class. The group is responsible to collect the data and implement the idea. Groups will be created no later than April 14. The final grade for each project is determined by the following components:
    - Project Idea (2%). Each group should prepare one paragraph (<250 words) to describe a project idea they will pursue during this quarter. This idea need not be final but must be thoughtful. The paragraph should include, briefly, the goal of the project, potential data sets, suitable techniques, and some feasibility assessment.
    - Proposal (3%). On May 5, each group must be submit a formal proposal of no more than 1000 words discussing in detail about their project. In addition to discussing the topics covered in the idea paragraph, the proposal should also include how the project will be managed (work breakdown, scheduling, organization, and roles of each group member).
    - Early report (5%). The purpose of an early report to encourage each group to start early so that they can overcome potential technical barriers that often appear in this stage of a project. This report should include a detailed description of the data to be used and a sound methodological framework. A sketch of the system to be designed should also be included and discussed.
    - Demonstration (15%). Each group will demonstrate their project (live!) on June 2 during the scheduled time for final examination. The proposal will be used as a major criterion to evaluate the demonstration. Peer review method *may be* used during the demonstration.
    - Final report (5%). This report concludes a project and should include the final discussion about the implemented functions/services in the original proposal. Some self-assessment as well as limitations should also be discussed. The final report is due on June 3.
- **Examination (20%)**. An close-book examination is scheduled in the final week.
- **Participation (20%)**. Attendance and participation in class discussion are expected of all students. More specifically, there are two kinds of activities.
    - Discussion (10%). Each morning meeting (except for the two case studies) will have an instructor-led session (about 2/3 of the class duration) and student-led discussions. Student-led discussions will be based on article reading or software experiments/tutorials. A student must lead at least one of the discussion during the quarter (bonus points may be given to those who are willing to do extra discussion). A software experiment/tutorial session is typically handled by more than one student. The materials used for discussion (slides, for example) must be ready before class.
    - Abstracts (10%). Each student must submit an abstract of no more than 500 words about the readings and software for each week. This does not include the chapters

of the textbook. This requirement is exempted for those who are scheduled to lead the discussion on the particular day.

Students must make sure their work meet the following requirements:

- All documents must be prepared using HTML (with a reasonably good style) and be submitted in a digital package (including images if applicable) using dedicated drop boxes prepared on carmen.
- The project documents are due before 23:59 PM of the specified dates.
- The abstracts are due before each Monday morning class (i.e., 8:30 AM).
- All documents are "final", meaning that I do not accept "updated" version after the due dates. It is necessary to submit your documents early since carmen may not be reliable at the last minute.

Students should have good work ethics when working on their group projects. Complaints can be expressed before the due date of the final report. Students who failed to improve their work ethics may receive zero point for their projects.

Schedule

The following is a tentative schedule. An active, more detailed schedule is available online; students should check the active schedule page frequently as new materials are made available before every week's class.

Week	Lecture	Lab	Progress
1	Introduction	Basics: HTML, CSS	
2	Fundamentals of (inter)networking	Basics: AJAX	
3	Enabling techniques	Basics: WMS/WFS	
4	Case studies (Google maps and KML)	Mashups: Google Maps	Groups
5	Standards (OGC, XML, GML)	MapServer	Idea
6	Distributed systems	Mashups: Geoserver	Proposal
7	Semantic web	MapServer	
8	Geospatial web	MapServer	

9	Case study	Projects	Early report
10	Demonstrations		Final report
11	Examination		

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Disability Services: Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD292-0901; http://www.ods.ohio-state.edu/.

GEOG 695 – Undergraduate Research and Professionalization Seminar

Spring 2009
5 credits

Instructor: Dr. Kendra McSweeney
Office: 1164 Derby Hall
E mail: mcsweeney.14@osu.edu
Phone: 247 6400
Office hours: Thursdays 1:00 3:00, or by appointment
Class: M W 1:00 2:48, Derby Hall 0155D
Call No. 10036 2

Overview
This course focuses on how to conduct research to understand the relationship between humans and their environment. The course meets twice a week and will be oriented around hands-on projects that will give students practical experience in generating, analyzing, and presenting geographic information. Students will learn how to draw on geographical theories to develop a research question, and how to write a formal research proposal based on preliminary independent research. The course is designed to be the capstone for geography majors. In-class examples may therefore emphasize geography's human-environment subfield, but the readings stress human geography in general. Students from all areas of geography are welcome.

A principal aim of the course is to offer students the opportunity to conceive of, plan for, and execute a research project while exploring a variety of methods for data construction and interpretation. Students interested in pursuing graduate work will find the course a good introduction to self-directed research, 'fieldwork,' and proposal-writing. For other students, the

course will offer the chance to develop skills that typically enhance employment opportunities, including formal presentation techniques, c.v. construction, and independent research methods.

Research topics will be identified early in the course, and students will regularly present reports to the class on their research progress. Students are encouraged to pursue their own research

interests. Third-year students may wish to explore ideas that can be developed as a Senior thesis

and/or as an entry for the Denman Undergraduate Research Competition. Seniors can use this as an opportunity to explore in more detail a research topic encountered earlier in their degree. Success in the course depends on students' engagement with the research process, not on the type of geographic topic they choose. Students are welcome to pursue topics more closely related to their own interests.

Because the quarter is a short time over which to develop a research project, the reading load is

relatively light for an upper-level seminar. At least one class meeting is reserved for individual

research.

Course Format
This undergraduate seminar meets twice a week. Mondays will generally be reserved for discussi ng the week's readings. Students will send in brief responses to the readings at least 2 hours prio r to each class for which the readings were assigned (i.e., by 11 am); these will help structure the discussion. As in most seminars, the instructor is facilitator more than lecturer, and students are e

xpected to come to class with the readings *read,* thought about, and in-hand, and ready to contrib

ute to class discussion. In fact, involvement in class discussion is critical to success in the course

. Wednesday meetings will be used primarily for in-class exercises, research reports, group work

, peer review and feedback, guest speakers, etc.

Readings
Readings will be drawn from a coursepack created for the course, which is available for $35.95 a t SBX Bookstore. Students are expected to bring the coursepack to each class. A copy will also b

e placed oon 3-hour reserve in Sullivant Library for emergency use only.

Evaluation
Participation in class discussion makes up 20% of your grade. 20% of your grade comes from bri

ef but substantive e-mail comments you will send me relating to the readings at least 2 hours prio

r to each class for which the readings were assigned. An additional 30% is comprised of three re ports on your research (10% each). The first report will be in poster format and will present a syn

opsis and evaluation of data on your research site derived from archival, official, non-official, an

d visual sources as well as at least one site visit. The second report will be a write-up (e.g., annot

ated transcript) of the raw data generated during interviews (type of interview is optional); the thi rd report is a properly referenced working bibliography on scholarly and other forms of secondar y data on the research topic.

The proposal writing process accounts for 30% of the final grade. A draft proposal is du e in class on Wednesday, May 23. The final proposal will not exceed 2,500 words (approximatel y 10 pages double spaced, 12 pt font), and is due Monday, June 4 by 5pm. A formal 15 minute presentation of the proposed research will be given in class on May 30 (10%). Every student is re sponsible for each of the written forms of evaluation although the option exists to conduct resear ch in pairs.

Class participation 20%
E mail comments on readings 20
Research Reports
I: Poster reports on research sites due in class 10 due W April 18
II: Reports on interviews due in class 10 due M May 7
III: Working bibliography due in class 10 due W May 16
Research Proposal Draft due in class 5 due W May 23
Presentation of Proposed Research 5 W May 30
Final Research Proposal, including 2 page c.v. 20 due M June 4

Opportunities for extra credit:
Throughout the quarter, visitors to the department or university will be speaking on themes close

ly related to geography and human environment relations. Some of these events are listed belo w in the schedule *[in italics];* others will be announced as they come up. Students are encourage d to attend these talks in order to learn from their content as well as from the speakers' presentati on style. By briefly but thoughtfully summarizing and critiquing one of these speaking events fo r the class, students can bolster their grade by a maximum of 5%.

Policies
All assigned work is due by 5 pm on the due date in the Geography Main Room (DB 1035). Lat e work will lose two (2) percentage points per day.

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Class and Reading Schedule
(subject to change)

Week 1. INTRODUCTION

M March 26 Introduction; basic concepts
In class reference:
• NRC, 1997. "Geography's perspectives"

W March 28 Research topics
Reading:
• Stoddart and Adams, 2004. "Fieldwork and unity in Geogra phy"
• Hoskin, B., W. Gill, and S. Burkill. 2003. "Research design for dissertations and projects."

- Bridge, G. 2001. “Everyday ecologies: cities, nature, and te aching urban ecology.”

Th March 29 Talk: Nancy Peluso, “Landscapes of Violence and Peace in West K alimantan, Indonesia,” 3:30 5 pm, Derby Hall 1080 (Reception t o follow in Derby Foyer)

Week 2. EXPLORING EXISTING DATA I

M April 2 Secondary and archival sources

Readings:

- Edmonds, 2001. “The pleasures and pitfalls of written recor ds.”
- Hunker, 2000. “Columbus: the physical setting.”

W April 4 Exploring your research topic with secondary & archival sources

Week 3. EXPLORING EXISTING DATA II

M April 9 ‘Non official’ sources

Readings:

- Cloke et al., 2004. “Non official sources”
- Lutz and Collins, 1993. “Fashions in the ethnic other”

W April 11 Interpreting visual imagery: photographs and maps

Readings:

- Hunker, H. L. 2000. “Time and change.”

Week 4. GENERATING DATA I: LANDSCAPE INTERPRETATION & ETHNOGRAPHY

M April 16 Site visits, ethnographies, ‘reading’ the landscape

Readings:

- Cloke et al., 2004. “Doing ethnographies”
- Birdsall, S. 2003. “Learning to see landscape through a flex ible lens”
- Hand out (not in course pack): Meinig, D. 1979. “The beh olding eye.”
- Hay, I. 2006. “Preparing a poster.”

W April 18 Putting method into practice
Due: Poster reports on 'place'

Week 5. GENERATING DATA II: TALKING TO PEOPLE

M April 23 Interviewing strategies and skills
Readings:
- Bridge, G. 2003. "Questionnarie surveys"
- Burgess, J. 2003. "The art of interviewing."
- Matheson, J. 2001. "Stranger, trailer, fieldwork, girl."

W April 25 Interviewing practicum

Week 6. ANALYSIS & INTERPRETATION

M April 30 Analyzing qualitative and quantitative data
Readings:
- Kneale, P. 2003. "Representing geographic information"
- Pentecost, A. 2003. "Analysing data."

W May 2 In the field

Th May 3 Talk: Bruce Braun, Title TBA, 3:30 5 pm, Derby Hall 1080

Week 7. EXPLAINING & UNDERSTANDING

M May 7 Putting it all together; revising aims, honing techniques
Reading:
- Cloke et al. 2004. "Explaining"
- Healey, M. 2003. "How to conduct a literature search."

Due: Research reports on iWnterview data

W May 9 In class data analysis and data presentation

Week 8. WRITING RESEARCH I

M May 14 Proposal writing
Readings:
- Cloke et al., 2004. "Representing human geographies";
- Heath, A. W. 1997. "The proposal in qualitative researc

h."

W May 16 Honing the literature review
Due: Working Bibliography

Week 9. WRITING RESEARCH II

M May 21 Final fieldwork/analysis/write up

W May 23 Draft proposal due for peer review
Writing a "Curriculum vitae"; how to present your research proposal
Reading:
Kearns, R. A. 2003. "Understanding assessment criteria"

Th May 24 Talk: Marshall Shepherd, Title TBA, Derby Hall 1080, 3:30 5 pm.

Week 10. M May 28 MEMORIAL DAY; no class
Reading:
• "Communications: The presentation"

W May 30 In class presentations

M June 4 Final Proposals due by 5 pm.
Th June 7 Grades posted by this date for all (incl. graduating seniors)

Geography 695
Research in Human Environment Geography

COURSE READING LIST

"R" denotes a reading intended primarily for in class reference.

Week 1
NRC. 1997. "Geography's perspectives." Pp. 28 46, *Rediscovering Geography: New Relevanc e for Science and Society.* Washington, DC: National Research Council.

Stoddart, D. R., and W. A. Adams 2004. Fieldwork and unity in Geography. In *Unifying Geogra phy: Common Heritage, Shared Future,* ed. J. A. Matthews and D. T. Herbert, 46 61. London: Routledge.

Hoskin, B., W. Gill, and S. Burkill. 2003. "Research design for dissertations and projects." Ch. 3 5 in A. Rogers and H. Viles, eds. *The Student's Companion to Geography,* 2nd ed. London: Blac kwell.

Bridge, G. 2001. "Everyday ecologies: cities, nature, and teaching urban ecology." *Journal of G*

eography 100:154 165.

Week 2

Edmonds, M. 2001. The pleasures and pitfalls of written records. In *The Historical Ecology Han dbook: a Restorationist s Guide to Reference Ecosystems*, ed. D. Egan and E. A. Howell, 73 1 00. Washington, DC: Island Press.

Hunker, H. L. 2000. Columbus: The Physical Setting (pp. 8 22). *Columbus, Ohio: A Personal Geography.* Columbus: Ohio State University Press.

Week 3

Cloke, P., I. Cook, P. Crang, M. Goodwin, J. Painter, and C. Philo. 2004. *Practicing Human Geo graphy*. London: SAGE. Ch. 3, "Non official sources"

Lutz, C. A., and J. L. Collins. 1993. *Reading National Geographic*. Chicago and London: Univer sity of Chicago Press. Ch. 5, "Fashions in the ethnic other"

Birdsall, S. S. 2003. Learning to see landscape through a flexible lens. *Journal of Geography* 102 (1):29 34.

Hunker, H. L. 2000. Time and Change (pp. 169 200). *Columbus, Ohio: A Personal Geography.* Columbus: Ohio State University Press.

Week 4

Cloke, P., I. Cook, P. Crang, M. Goodwin, J. Painter, and C. Philo. 2004. *Practicing Human Geo graphy*. London: SAGE. Ch. 6, "Doing Ethnographies"

R Hay, Iain. 2006. Preparing a poster (pp. 93 108). *Communicating in Geography and the Envi ronmental Sciences*, 4th ed. Oxford, UK: Oxford University Press.

Week 5

Bridge, G. 2003. "Questionnaire surveys." Ch. 40 in A. Rogers and H. Viles, eds. *The Student's Companion to Geography*, 2nd ed. London: Blackwell.

Burgess, J. 2003. "The art of interviewing." Ch. 4 in A. Rogers and H. Viles, eds. *The Student's Companion to Geography*, 2nd ed. London: Blackwell.

Matheson, J. 2001. Stranger, trail, fieldwork, girl. *Geographical Review* 91(1 2):225 230.

Week 6

Kneale, P.E. 2003. Ch. 22, "Representing geographic information," *Study Skills for Geography Students: A Practical Guide*, 2nd ed. London: Arnold.

Pentecost, A. 2003. "Analysing data." Ch. 36 in A. Rogers and H. Viles, eds. *The Student's Com panion to Geography*, 2nd ed. London: Blackwell.

Week 7

Cloke, P., I. Cook, P. Crang, M. Goodwin, J. Painter, and C. Philo. 2004. *Practicing Human Geography*. London: SAGE. Ch. 9, "Explaining"

R Healey, M. 2003. "How to conduct a literature search." Ch. 2 *in* N. J. Clifford and G. Valentine, eds. *Key Methods in Geography.* London: Sage.

Week 8

Cloke, P., I. Cook, P. Crang, M. Goodwin, J. Painter, and C. Philo. 2004. *Practicing Human Geography*. London: SAGE. Ch. 11, "Representing human geographies"

Heath, A. W. 1997. "The proposal in qualitative research." Available online at: http://www.nova.edu/~ron/heath.html. Accessed 23 March 2006.

Week 9

Kearns, R. A. 2003. "Understanding assessment criteria." Ch. 30 *in* N. J. Clifford and G. Valentine, eds. *Key Methods in Geography.* London: Sage.

Week 10

Anon. "Communications: The Presentation Structure." UniS Skills Project Pilot Pack: Oral Presentations. On line at http://www.surrey.ac.uk/Skills/pack/comms/start.html. Accessed 23 May 2005.