Proposal for a Minor in Geographic Information Science

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24 January 2013

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Introduction

The purpose of this document is to propose a new Minor in Geographic Information Science within the Department of Geography in the College of Liberal Arts & Sciences at The University of Iowa. This minor is designed to recognize learning in a specialized group of courses that provides a set of skills and concepts that is in demand. The learning outcomes will be 1) understanding fundamental concepts for the field of geographic information science (GIScience), including geographic information systems (GIS), remote sensing, and global positioning systems, 2) basic proficiency in using geographic information systems software; and 3) an appreciation of the value and special properties of spatial data in applications. Students attaining the minor will be prepared to apply this information in areas such as location-based decision-making, urban and regional planning, environmental management, and public health among others.

Background

Geographic Information Science is the study of geography through the lens of digital technology. This field comprises the use of geographic information systems (an assemblage of computer-based technologies designed to facilitate the capture, organization, analysis, and display of geographic data), remote sensing (primarily interpretation of satellite imagery), and spatial modeling (viewing, analyzing, and mapping spatial data) to examine geographic patterns and processes – PLUS research on the nature, development, and use of these tools.

A strong demand exists for individuals experienced with GIS and related spatial technologies in the American workforce. GIS is used for tasks ranging from the exploration of Mars to assigning daily duties to local utilities workers and, thus, cuts across disciplines and job classifications. A minor in GIScience will provide students with a credential that communicates to potential employers that they have attained foundational knowledge in this area that complements their major.

The Department of Geography at UI has a strong program in GIScience with 12 courses relating to this field. This strength was noted in the most recent external review, now in the response stage between the department and the Dean. The department has had a GIScience track within the major for over 20 years. The program provides solid training in the technical aspects of GIS and in its applications, and many students develop senior research projects using the GIScience skills they have developed in multiple classes. Beyond applications, the Department of Geography at UI is well regarded for its contributions to leading GIScience theory, and faculty members have made contributions to core concepts of GIScience, including issues related to the ethical use of related technologies and data – all of which are included in undergraduate courses.

The introductory course 44:005(GEOG:1050) Foundations of Geographic Information Science is required for majors in Environmental Science and in Environmental Policy & Planning (as well as Geography). Students in these majors could benefit from adding additional coursework in GIScience, especially if it is clearly recognized on their transcripts and so easily identified by potential employers. A set of GIScience skills is also relevant to students wishing to pursue work or further education in areas ranging from anthropology to public health. Currently, students from the Departments of Anthropology, Geoscience, and Civil & Environmental Engineering regularly take GIS courses. Examples of areas for which the minor would be good preparation include the College of Public Health and the School of Urban and Regional Planning, whose students regularly seek out GIScience courses, and the IGERT program in Geoinformatics for Environmental and Energy Modeling and Prediction (GEEMaP) (including
the Departments of Computer Science, Political Science, Sociology, and Statistics in CLAS and Civil & Environmental Engineering for which undergraduates need preparation.

The Proposed Minor

This proposed minor will offer a group of courses that already exist and that are taught in the geography curriculum, creating a foundation for understanding this approach to geographic and spatial problems. This minor will provide a recognizable, meaningful label for a concentration of courses completed by students in the minor.

The minor consists of:

a) A core course.
b) A mid-level course in each of three specializations within GISci.
c) An advanced course that builds on one of the three mid-level courses.

The proposed curriculum:

**CORE COURSE – The following is required:**

044:005(GEOG:1050) Foundations of Geographic Information Science

**MID-LEVEL COURSEs – all of the following three are required:**

44:105(GEOG:3500) Introduction to Environmental Remote Sensing

44:109(GEOG:3540) Geographic Visualization

44:110(GEOG:3520) GIS for Environmental Studies: Introduction

**ADVANCED COURSES – one of the following is required:**

44:128(GEOG:4520) GIS for Environmental Studies: Applications

44:137(GEOG:4150) Health and Environment: GIS Applications

44:139(GEOG:4570) Spatial Analysis and Location Models

44:141(GEOG:4580) Introduction to Geographic Databases

44:142(GEOG:4650) Simulation in Environmental Geography

44:145(GEOG:4500) Applications in Environmental Remote Sensing

44:146(GEOG:3570) Light Detection and Ranging (LiDAR): Principles and Applications

44:181(GEOG:4020) Field Methods: Mapping and Mobile Computing

Course descriptions, with prerequisites

**044:005 (GEOG:1050) Foundations of GIS**

3 s.h.
Cartography, map analysis, and geographic information systems; map projections and scale; data collection, remote sensing, and GPS; data structures and organization; cartometry; symbolization and visualization.

**044:105 (GEOG:3500) Introduction to Environmental Remote Sensing**

3 s.h.
Basic concepts and principles of remote sensing; sources of data; georegistration; digital
processing and classification of remotely sensed images for extraction of environmental information; linkage of remote sensing techniques with GIS analysis.

**044:109 (GEOG:3540) Introduction to Geographic Visualization**  
3 s.h.  
Basic concepts and techniques that underlie cartographic representation and the broader field of geographic visualization; digital cartographic practices; how scientific visualization, information visualization, and user interface design contribute to geographic visualization; map symbolization, scale and generalization, animation and dynamic map design, multimedia, virtual and mixed environments, interfaces for GIS; experience applying cartographic and visualization techniques. Prerequisites: 044:005 (GEOG:1050).

**044:110 (GEOG:3520) GIS for Environmental Studies: Introduction**  
3 s.h.  
Methods of managing and processing geographic information for environmental analysis; basic concepts, structures, theories of geographic information system (GIS), basic analytical techniques, and hands-on experience in GIS operations. Prerequisites: 044:005 (GEOG:1050).

**044:128 (GEOG:4520) GIS for Environmental Studies: Applications**  
3 s.h.  
Applications of geographic information system (GIS) techniques in environmental change analysis (especially land use/cover change), environmental assessment, hazard/risk analysis, environmental decision making. Prerequisites: 044:110 (GEOG:3520).

**044:137 (GEOG:4150) Health and Environment: GIS Applications**  
3 s.h.  
Applications of GIS and spatial analysis for studying health outcomes and exposure to environmental contaminants at different geographical scales. Same as 152:139 (GHS:4150).

**044:139 (GEOG:4570) Spatial Analysis and Location Models**  
3 s.h.  
Application of location models within GIS environments to support decision making; small area demographic forecasting, location-allocation models, regionalization problems, shortest path models, other spatial analysis methods used to support spatial decisions. Prerequisites: 044:005 (GEOG:1050).

**044:141 (GEOG:4580) Introduction to Geographic Databases**  
3 s.h.  
Fundamentals of database design and use for geographic or environmental domains; major database models and how they support geographic data; introduction to SQL for formulating database queries; experience using software for applying key database concepts. Prerequisites: 044:005 (GEOG:1050).

**044:142 (GEOG:4650) Simulation in Environmental Geography**  
3 s.h.  
How computer simulations are used in environmental studies, with focus on landscape ecology (spatial patterns of organisms and ecosystems); basics of performing simulations; principles and applications of simulation through readings and performing simulations; frontiers of simulation use in the field; hands-on experience writing computer simulations that capture environmental processes (e.g., changing climate, predator-prey relations, nutrient flux), and analyzing the outcomes. Requirements: advanced courses in environmental geography or environmental science and senior standing.

**044:145 (GEOG:4500) Applications in Environmental Remote Sensing**  
4 s.h.  
Theory and practice of remote sensing and digital image processing; practical applications to human-environment interactions. Recommendations: 044:105 (GEOG:3500) or 012:110 (GEOS:3100) or 159:110 (ENVS:3100).

**044:146 (GEOG:3570) Light Detection and Ranging (LiDAR): Principles and Applications**  
3 s.h.  
Basic principles and applications of Light Detection and Ranging (LiDAR); LiDAR as an essential technology for mapping and analysis of a vast range of surfaces; application examples include floodplain mapping, forestry management, transportation planning, vegetation analysis, urban planning, and 3-D modeling; theoretical understanding and practical experience using different software. Prerequisites: 044:005 (GEOG:1050). Recommendations: 012:110 (GEOS:3100) or 044:105 (GEOG:3500).

**044:181 (GEOG:4020) Field Methods: Mapping and Mobile Computing**  
3 s.h.  

Development and application of mobile geographic information technologies; key issues associated with global positioning systems (GPS), wireless technologies, field-based data collection and analysis, ubiquitous computing, and location-based services; experience using GPS, advanced mobile computing technologies, mobile GIS software to construct geographic datasets, and data sampling techniques.

Please note the following:

- The number of courses and their levels are the same as most other minors in CLAS. The minor requires 3 s.h. below the 100-level and 12 s.h. of 100-level courses.

- Students must maintain a g.p.a. of at least 2.00 in the minor. Courses for the minor may not be taken pass/nonpass.

- The core course is taught every semester. The mid-level courses are taught every year. Other courses are taught at least every other year, but may be more often.

- We see no issues involving transfer, duplication, or regression that differ from any other minor.

- 3 s.h. of transfer credits will be accepted while at least 12 s.h. must be taken at The University of Iowa.

- The GISience minor is designed for non-Geography majors since students in Geography interested in GIScience are already likely to be in the GIScience track, and adding this minor to a different track could lead to more than 50 sh in geography. Geography majors may not minor in Geographic Information Science.

- This program does not add new costs. No new faculty personnel are needed now or in the next 5 years.

- If approved, the minor would be implemented in Fall 2013.