

University of Washington

Department of Geography

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Geographic Information Science and Systems Overview

Over the past two decades there has been a continuing stream of fundamental advances in the development of concepts behind the information technologies used in working with geographical information in a number of disciplines, including geography. Advancement in concepts is now being called geographic information science (GIScience). Advancement in the information technology is now often referred to as GISystems. Together, the predominant term is still GIS. GIS instruction and research incorporates aspects of information science and information technology within Department of Geography at the University of Washington (UW).

GIS information technology has been driven by diverse application needs as much as it has the intellectual interest of developing the concepts behind the technology. Individuals, groups, communities, organizations, private-public partnerships, and consortiums adopt GIS as an effective means for dealing with large, multi-faceted databases within which locational relationships are particularly significant. GIS databases extend and enhance our ability to work with maps in a variety of ways and in a wide variety of domains. GIS and related geospatial technologies are used to carry out geographic data analysis from the local to global scales. There are too many applications to name. No one has ever enumerated a complete list.

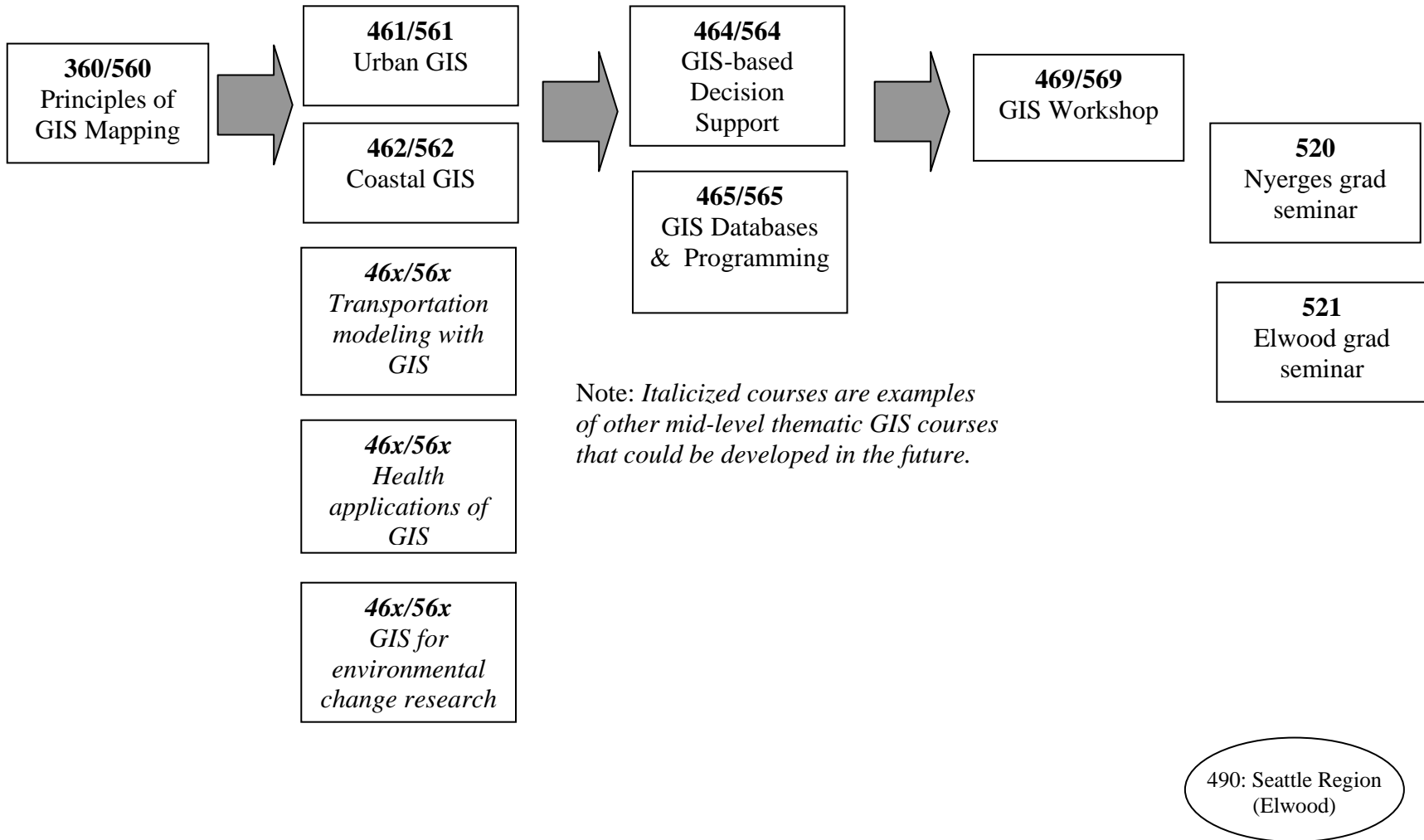
Although the specific information requirements differ across this range of applications, there are many commonalities in the underlying data management, analysis, and display technologies. Those commonalities come together as a basis for addressing complex geospatial problems in integrated ways. As such, GIS is an information integration technology, which is why so many groups, organizations, etc. are deploying it to address long existing issues with new insight.

Associate Professor Sarah Elwood and Professor Tim Nyerges are the principal faculty in the UW Department of Geography hired to teach courses related to geographic information science and geographic information systems. From time to time other faculty, e.g. Professor J W Harrington and Associate Professor Suzanne Davies Withers have taught GIS courses in the Department in the recent past.

The Geography Department works with other units on the UW campus in fostering a creative instruction and research environment for both undergraduate and graduate students. The GIS program in the Department of Geography provides education to many undergraduate and graduate students who find positions in academe, research institutes, government agencies, and private industry around the world. The local internship program has been quite effective in integrating practical experience into their education. The Geography Department has always promoted the value of student diversity within the Department as well as across campus. A diverse student population broadens learning perspectives, and from this faculty, staff and students learn to address complex problems in more flexible ways, promoting efficient, effective and equitable solutions. The Geography Department is seeking new opportunities to increase its student body diversity at both the undergraduate and graduate levels.

The following pages present the UW Geography Department curriculum.

Course structural sequence for students.



Elwood and Nyerges teaching schedule on a 2 year cycle.

Year 1 Fall

Elwood – 360/560
Elwood – 490
Nyerges 462/562

Year 1 Winter

Elwood – 461/561
Nyerges 465/565

Year 1 Spring

Nyerges – 360/560
Nyerges – 469/569
Elwood – 521

Year 2 Fall

Elwood – 360/560
Elwood – 490
Nyerges 462/562

Year 2 Winter

Elwood – 461/561
Nyerges 464/564

Year 2 Spring

Nyerges – 360/560
Elwood – 469/569
Nyerges 520

Students can enter the sequence (360/560) in fall or spring

Tim Nyerges and Sarah Elwood offer 469/569, “GIS Workshop” in alternating years.

Tim Nyerges and Sarah Elwood offer their own version of a graduate seminar in GIS in alternating years.

Additional GIS courses to teach as faculty resources allow:

367: Economic applications of GIS

Course Descriptions

Geography 360/560: Principles of GIS Mapping (Elwood Autumn and Nyerges Spring)

Geography 360/560 provides students with an opportunity to learn and use concepts, techniques, and software tools that are part of geographic information systems (GIS). GIS brings together traditional cartographic principles, computer assisted analytical cartography, relational database design, and digital image processing and analysis to enable people to develop geospatial databases, analyze those databases and depict them in the form of 2D and 3D map displays. Students apply principles of map design for different types of maps depicting sustainability – social, economic, and environmental - topics at geographic scales from global to local. Students practice critical thinking skills during geographic information representation and use of GIS mapping software. Geography 360 is for undergraduate students, and graduate students should register for Geography 560. No previous work in GIS is necessary.

Geography 461/561 Urban GIS (Elwood Winter)

Geography 461/561 is designed for students with previous introductory-level coursework in GIS who wish to develop further expertise in urban applications of GIS. Within this focus on urban applications, students explore urban spatial analysis and decision making in a GIS environment, including project planning, spatial data acquisition, data preparation and coding, analysis and visualization of project findings, and communication and implementation of project results. Students gain experience in locating and obtaining geospatial data from local, state, and federal government sources; developing primary data for urban spatial analysis; and analyzing and representing these data using a desktop GIS software. We examine a range of urban applications of GIS by local government, but also non-governmental users such as neighborhood activist organizations, paying particular attention to the differing hardware, software, data, and 'human' resources and needs of these different user groups. Geography 360/560 or an equivalent is a prerequisite background for this course. Geography 461 is for undergraduate students, and graduate students should register for Geography 561.

Geography 462/562 Coastal GIS (Nyerges Autumn)

Geography 462/562 provides students with a learning experience that links the theory underlying geographic information systems with its application in a coastal application domain. The course combines an overview of general principles of geographic information science and practical experience in the analytical use of geospatial information. The lectures introduce students to the analytical treatment of geographic information using several frameworks for understanding data, software operations, and systems. The course adopts a thematic focus on coastal concerns in the Puget Sound Region, particularly nearshore vulnerability using an environment-society perspective. Coastal is defined as the watershed basins that drain into Puget Sound as well as the water of Puget Sound, including social and natural features in those areas. Student lab assignments using GIS software make use of coastal data sets from Puget Sound to address feature measurement, characterization, and movement related to the land-water interface. Geography 360/560 or an equivalent is a prerequisite background for this

course. Geography 462 is for undergraduate students, and graduate students should register for Geography 562.

Geography 464/564 GIS-based Decision Support (Nyerges every other Winter)

Geography 464/564 provides students with a learning experience about “GIS methods” in the context of several pervasive decision support contexts facing urban-regional settings. Two significant categories characterize the decision support contexts – topics and decision situations. Three inter-related topics – land use, transportation, and water resources – are fundamental to how people upgrade and/or degrade the quality of life in communities, each having a significant influence on the natural environment. Three pervasive decision situations – planning, improvement programming, and project implementation – are ways that communities attempt to address quality of life changes in the long, medium and short terms. Students work with GIS methods in both commercial-off-the-shelf and customized software to address various decision support scenarios that characterize those nine contexts (of 3 topics by 3 decision situations). Students gain exposure to group-based decision support methods to address those nine contexts; those contexts being among the most complex and important topics in the 21st century, particularly in coastal urban-regional settings where pressures from population growth are continuing to place pressures on natural resources in ever expanding ways. Geography 461/561 or 462/562 are the respective prerequisite background for this course. Geography 464 is for undergraduate students, and graduate students should register for Geography 564.

Geography 465/565 GIS Databases & Programming (Nyerges every other Winter)

Geography 465/565 provides students with a learning experience that links the development and use of databases set within the context of a computer programming activity. Digital maps have always been thought of as databases used for analysis as much as they have been for display. GIS databases are the foundation of GIS work, whether for analysis and/or display. We emphasize “transformations” within and among spatial database management, spatial analysis, and geovisualization display techniques. Each of those technique areas involves a type of language for processing data and converting it into information as appropriate to context. The course makes a connection to the four user-interface modes of ArcGIS geoprocessing: command line, dialog box, ModelBuilder, and Python Scripting. Each has its advantages. The course lab assignments focus on the Python programming/scripting interface so that students can develop skills with a programming/scripting language. Students will undertake lab exercises to learn about ArcGIS geoprocessing, making use of environmentally related datasets (air, soils, and water) provided by instructors. Students can work in study groups, but assignments will be turned in as individuals. Geography 461/561 or 462/562 is a prerequisite background for this course. Geography 465 is for undergraduate students, and graduate students should register for Geography 565.

Geography 469/569 GIS Workshop (Elwood or Nyerges every other Spring)

Geography 469/569 is designed as the capstone experience in the Department of Geography GIS curriculum. The main course goal is that students become independent and effective GIS users who can develop and use GIS databases for spatial analysis and

problem solving, meeting the needs of project partners. The course is an intensive workshop that involves hands-on experience in which student teams will develop GIS data analysis as part of applications working in collaboration with local partners (who may be from the University, community agencies, or local government). In contrast to introductory GIS courses (which ask you to build conceptual understanding and applied skills in spatial data representation and manipulation in GIS), this course immerses students in the full range of tasks associated with a GIS application. Working in teams, students communicate with project partners to identify project goals, acquire and prepare spatial data for GIS data analysis, communicate with project partners to assess progress, manage spatial data, and produce necessary maps for presentation as part of a final report. In lecture and readings, students examine GIS project management strategies (in a variety of organizational and application contexts), and concepts and skills for data acquisition, data preparation, and database design. Geography 460, 461, Urban Design and Planning 422, or permission of the instructor is the necessary background to enroll in this course. Geography 469 is for undergraduate students, and graduate students should register for Geography 569.

Geography 520 Geographic Information Representation (Nyerges every other Spring)

Geography 520 seminar provides students an opportunity to discuss the motivations, development, and use of geographic information representations, particularly problem scoping, database design, modeling, and displays of information for land use, transportation and water resource management and decision making. Geographic information representation is a fundamental aspect of geographic information use – both in theory and in practice – for all of the aforementioned activities. Given the growing interest in group-based information use, the seminar focuses on Internet GIS, WebGIS, Participatory GIS (PGIS), Public Participation GIS (PPGIS) that can be used to support efforts for addressing environmental issues. We discuss approaches to information needs, system requirements, technology implementations, and the use of systems. We will explore and critique example systems. Feasibility of Internet GIS functionality will be considered in terms of system architectures. Multiple phases of GIS data processing are addressed in terms of “information structures” to promote shared understanding among broad-based groups of people. An information structure is a representation of information potentially understandable by a broad group of people, e.g., value trees, decision paths, maps, timelines, tables, and commenting windows, and other such conventions that foster analysis and deliberation about geospatial information. Such information structures are the underpinnings of intellectual artifacts to support analytic-deliberative dialog about complex geographical problems, e.g. land use, transportation, and water resource sustainability. A research paper is required that deals with a topic of your choice but contextualized by reading material and discussion from class as well as your own literature survey. Previous work in GIS is a prerequisite for enrollment in the course.

Geography 521 Critical GIS (Elwood every other spring)

Geography 521 explores critical GIS, a research program that engages both GIScience and critical theory in geography. Taking seriously the notion of GIS as socially and

politically constructed, critical GIS has sought to re-examine (and in some cases, re-invent) epistemologies, methodologies, and applications of GIS, spatial analysis, and digital spatial data structures and representation. Though Critical GIS is defined in many different ways, some of its central commitments include examining GIS and spatial data as inherently political; using GIS within a diversity of epistemological perspectives, expanding access to and participation in GIS through interventions in the technology itself and the decision-making processes in which it is used; and producing and using GIS in ways that challenge a social, political, and economic inequities.