Geographic Information Systems

Geographic information systems (GIS) display and manage all types of data over time, usually in the form of maps, charts and reports that help with the analysis of patterns and trends.

GIS technology, easily integrated into any organization's information system, provides a quick and effective method for sharing data visually and for solving spatial problems. GIS is widely used in many fields and industries, including environmental science, architecture, engineering, medicine, municipal government, public health, social work, business, and a variety of research enterprises.

The 18-unit **Certificate in Geographic Information Systems** offered through the School of Continuing & Professional Studies teaches both fundamental and advanced concepts and skills, including the design of GIS projects, the operation of software, cartographic output, spatial analysis, and industry-specific applications of GIS. The certificate targets working professionals seeking course work and skill enhancement in the field, as well as students wishing to complement their academic interests with additional training in GIS.

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Requirements

Certificate in Geographic Information Systems

Required Courses: 15 units

Code	Title	Units
GIS 200	Introduction to GIS	3
GIS 300	Advanced GIS	3
GIS 303	Digital Cartography	3
GIS 421	Spatial Data Modeling and Design	3
GIS 422	GIS Clinic	3
Total Units		**15**

Elective Courses: 3 units

Code	Title	Units
GIS 310	GIS Programming	3
GIS 410	Applications in Geospatial Intelligence	3
GIS 435	Applications in Imagery Analysis	3
Other courses with approval		

Courses

Visit online course listings to view semester offerings for U90 GIS (https://courses.wustl.edu/CourseInfo.aspx?sch=U&dept=U90&crslvl=1:4).

U90 GIS 200 Introduction to GIS
This course introduces students to the fundamental principles and applications of geographic information systems (GIS), their underlying geospatial science and spatial thinking. This problem-based course explores applications of GIS to spatial questions in the areas of social science, business, the humanities and earth sciences. Example topics include understanding spatial data types; map coordinate systems and projections; basic spatial data analysis; acquiring, editing, creating and managing geospatial data; and processing and visualizing data using GIS. This hands-on course works through problems using ESRI ArcGIS software (primarily ArcGIS Pro), but other open source tools will also be introduced. Students who complete this course should be able to apply skills to think through a spatial problem and employ GIS tools to address it.
Credit 3 units. UColl: OLH, OLI

U90 GIS 300 Advanced GIS
This course is designed to move beyond fundamental data presentation and map production skills. Primary emphasis will be on applying fundamental GIS concepts, performing spatial analysis, developing proficiency with GIS software applications, resolution of problems, and efficient delivery of results. A semester project will provide experience in the planning and execution of real-world projects using geospatial technology. Course objectives include applying fundamental GIS concepts, performing spatial analysis, developing proficiency with core ArcGIS software and selected extensions, resolution of problems, and efficient delivery of results. Completion of an introductory level GIS course is a prerequisite.
Credit 3 units.

U90 GIS 303 Digital Cartography
In today's world, it is imperative that students develop the necessary skills to communicate their ideas to a large audience in an efficient manner. Graphics and visual representations are one of the most effective ways to neatly convey complex data sets to readers. This course presents both theoretical and hands-on mapping and graphical problems to students. Students will learn to solve these problems with self-created solutions. The course teaches students the basics of GIS-based mapping for producing publishable work. Students will develop basic skills in computer-aided mapping and computer drafting primarily using the ArcGIS Suite of desktop software, ArcGIS and Google online web mapping, and other tools. Students will also be introduced to other mapping or statistical programs as needed.
Credit 3 units. UColl: OLH, OLI

U90 GIS 310 GIS Programming
This course introduces students to the use of programming in desktop and web geographic information systems (GIS). The course will be divided into two units: the first unit will focus on scripting for task automation, while the focus of the second unit will be web development. Topics include general programming concepts, using spatial libraries for both Python and R, the ArcGIS API for JavaScript, Leaflet, and consuming and publishing map services. Prerequisite: Introduction to GIS (U90 GIS 200) or Applications of GIS (EnSt 380/580).
Credit 3 units. UColl: OLH

U90 GIS 310M GIS Programming
Online version of U90 310. This course introduces students to the use of programming in desktop and web geographic information systems. The course will be divided into two units: the first will focus on scripting for task automation, while the focus of the second unit will be web development. Topics include general programming concepts using spatial libraries for both Python and R, the ArcGIS API for JavaScript, Leaflet, and consuming and publishing map services. Prerequisite: U90 GIS 200 or EnSt 380/580.
Credit 3 units. UColl: OLI

U90 GIS 313H Open Source GIS
Online hybrid version of the course U90 313. This course explores the open source options available for GIS users. Most students learn GIS on ESRI's ArcGIS platform. While robust, ArcGIS comes with a heavy price tag and may not be feasible for all GIS users. In this course, we will not only learn about how to find open source (free) GIS software, we will also learn how to use four of the major platforms available. We will start by learning QGIS, which is comparable to ESRI's ArcMap/ArcGIS Pro. Students will become intermediate users of QGIS. During the second half of the semester, we will spend time learning R, GeoDa and GRASS GIS. Prerequisite: an introductory GIS course or permission of the instructor.
Credit 3 units. UColl: OLH, OLI

U90 GIS 410 Applications in Geospatial Intelligence
This course introduces the concept of geospatial intelligence (GEOINT) and demonstrates how location can be used to identify patterns, visualize connections, and define relationships to ultimately "see what others can't." Learn about the Intelligence Cycle, the mission of the National Geospatial-Intelligence Agency (NGA) and other members of the Intelligence Community (IC), as well as potential career pathways in GEOINT. Students will learn how to leverage GIS to solve problems and make decisions related to Intelligence. This course features both a theoretical understanding provided by subject matter experts (SME) from the industry, as well as a practical understanding through hands-on exercises using ArcGIS Pro Intelligence and other Esri software applications. Prerequisite: Introduction to GIS (U90-200 or L82-380).
Credit 3 units. UColl: OLH

U90 GIS 420 Using GIS in International Affairs
This course studies the concept of spatial thinking, which will help students determine why and when to use GIS to address a problem. Students will explore some tools available for visualizing and analyzing data, primarily using ArcGIS and QGIS. The class will be divided into sections based on different kinds of problems (e.g., demography, microeconomics, history, environment) with an international affairs focus. Each class will have an online prompt, to which students are expected to respond. Students will learn skills that may help address the problem, work together in pairs on the problem, and with the class explore ways to improve their solution.
Same as U85 IA 420
Credit 3 units.

U90 GIS 421 Spatial Data Modeling and Design
This course expands on the fundamental principles of geographic information systems (GIS) and introduces advanced spatial database concepts and a visual programming environment for automating geoprocessing tasks. The course is divided into two parts: the first exploring spatial database design with emphasis on the ESRI Geodatabase, and the second focusing on automating workflows using ESRI ModelBuilder. Topics include data needs assessment; conceptual modeling, logical design, and physical implementation; using models to perform multi-step spatial analyses; and the automation of repetitive

processes with iteration tools. Lectures are supplemented with lab exercises to develop proficiency and problem-solving skills using ArcGIS software and associated tools. Prerequisite: the course should be taken after or concurrently with Advanced GIS (U90 GIS 300).
Credit 3 units. UColl: OLH, OLI

U90 GIS 421H Spatial Data Modeling and Design
Online hybrid version of the course U90 421; fulfills the same program requirements. This course expands on the fundamental principles of geographic information systems (GIS) and introduces advanced spatial database concepts and a visual programming environment for automating geoprocessing tasks. The course is divided into two parts: the first exploring spatial database design with emphasis on the ESRI Geodatabase and the second focusing on automating workflows using ESRI ModelBuilder. Topics include data needs assessment; conceptual modeling, logical design, and physical implementation; using models to perform multistep spatial analyses; and the automation of repetitive processes with iteration tools. Lectures are supplemented with lab exercises to develop proficiency and problem-solving skills using ArcGIS software and associated tools. Prerequisite/Corequisite: Advanced GIS (U90 GIS 300).

U90 GIS 422 GIS Clinic
The GIS Clinic is the culminating experience in the GIS Certificate Program. Students complete a project in a real work setting to provide direct experience with geospatial concepts and data. Students apply concepts and tools covered in all courses comprising the GIS Certificate program. GIS Clinic requires students to work on projects beginning to end, both under supervision and independently. The Clinic provides professional services to the university community as well as to outside organizations. Possible clinic settings include working with faculty on research projects using GIS, working with local organizations to develop GIS data, and working on regional GIS initiatives. Prerequisite: All other GIS Certificate requirements are expected to be completed prior to enrolling in the Clinic.
Credit 3 units.

U90 GIS 425 Public Health Applications of GIS
This course is designed to strengthen data preparation, presentation, analysis, and map production skills within the context of public health. The goal is to help the student understand advanced GIS analysis tools and techniques while providing experience in the planning and execution of real-world projects. Primary emphasis will be on applying fundamental GIS concepts, performing spatial analysis, developing proficiency with popular GIS software applications, resolution of problems, and effective delivery of results. The course is divided into five sections, each exploring a different aspect of the public health sphere. Each section will be structured as an individual project that will include data gathering, spatial analysis, and presentation of results. Project work will be collaboratively designed and managed by the class. GIS projects typically involve a progression of tasks and this course will incorporate a project model to illustrate the workflow (steps required) to move from an idea to a finished product. Prerequisite: Introduction to GIS (U90 GIS 200) or Applications of GIS (EnSt 380/580).
Credit 3 units.

U90 GIS 427 Public Sector Applications of GIS
This course examines the use of geographic information systems (GIS) and geographic information science in the public sector, with a focus on GIS applications in local government and municipality services. The course requires an understanding of fundamental GIS principles, and will address practical application of fundamental and advanced GIS concepts and practices. Topics addressed include GIS implementation at the organization and department levels, problem solving with GIS,

and geospatial project management. Lectures are integrated with lab sessions using GIS software including ArcGIS, Google Earth, and Open Street Map. Prerequisite: Introduction to GIS (U90 GIS 200) or Applications of GIS (EnSt 380/580).
Credit 3 units. UColl: OLH, OLI

U90 GIS 430 Geospatial Thinking for Teachers: Using a Geospatial Thinking and Technology Lens

This course is designed to equip upper elementary and middle school teachers (grades 3-8) with strategies to make curricular connections through a geospatial thinking lens. Teachers will support and enhance content delivery by creating opportunities for students to become real world problem solvers at the local, national, and global level. Teachers will learn strategies for engaging students in geospatial thinking and grade level appropriate technology practices, as they seamlessly integrate the disciplinary core ideas of math, science, social studies, computer science, and other related content areas. This curriculum driven course will include engaging field experiences to demonstrate how teachers can expose and promote the STEM pipeline to their students, while addressing cross curricular standard connections.
Credit 3 units.

U90 GIS 435 Applications in Imagery Analysis

This course exposes students to the range of applications of imagery analysis. Topics will include remote sensing concepts and instrumentation; the history of aerial photography and satellite remote sensing; and common techniques and workflows used to prepare and perform such tasks as digital imagery processing, imagery classification, and change detection. Furthermore, students will be introduced to industry applications and learn about the remote sensing job market. Students will perform hands-on lab activities to reinforce the concepts covered in lectures and readings. Students will also have the chance to interact with professionals in the field through guest lectures. Most activities will be performed using ArcGIS Pro software and extensions.
Credit 3 units. UColl: OLI