**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, which is 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 University College teaches both fundamental and advanced concepts and skills, including the design of GIS projects, the operation of GIS 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

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>GIS 200</td>
<td>Introduction to GIS</td>
<td>3</td>
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<tr>
<td>GIS 300</td>
<td>Advanced GIS</td>
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<td>GIS 303</td>
<td>Digital Cartography</td>
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<td>GIS 421</td>
<td>Spatial Data Modeling and Design</td>
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<td>GIS 422</td>
<td>GIS Clinic</td>
<td>3</td>
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<td><strong>Total Units</strong></td>
<td></td>
<td><strong>15</strong></td>
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**Elective Courses:** 3 units

**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](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) as well as 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 (mainly) ESRI ArcGIS software (including ArcMap and ArcCatalog), but other open-source tools will also be introduced. Students who complete this course should be able to apply the skills to think through a spatial problem and employ GIS tools to address it. Credit 3 units. UColl: 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. Arch: NSM Art: NSM Credit 3 units. Arch: NSM Art: NSM UColl: OLI

**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.
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. UCall: OLI

U90 GIS 310M GIS Programming

Online version of the course U90 310. 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. UCall: 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. UCall: OLH, OLI

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 GeoDa and GRASS GIS. 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. UCall: 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 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/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: OLI, OLI