

# GEOGRAPHIC INFORMATION SYSTEMS

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## Certificate in Geographic Information Systems

The certificate in Geographic Information Systems is offered online or on campus at the University of Denver in the evenings, or in a combination of both, to meet the needs of busy adults. University College offers the region's first complete graduate certificate program in Geographic Information Systems. Designed and delivered for busy adults, the Geographic Information Systems graduate certificate helps professionals add to their skillset with technology skills that help solve real-world spatial problems.

Certificate students receive applied instruction from professional practitioners who work in the fields in which they teach as they learn to plan, implement, and execute a project using GIS, GPS, remote sensing, internet mapping, or digital image processing. The GIS certificate allows students to explore training fundamentals at a very hands-on, applied level necessary to succeed in the field.

Gain a contextual background in GIS, from the management of natural resources to public utility management, public works engineering, environmental impact assessment, and even market research. In a burgeoning integrative world, it is vital to grasp the diverse fundamentals of each topic within the Geographic Information Systems industry and gain an insider's perspective to specific fields as they each relate to GIS training. Credits earned through this graduate certificate may apply toward a master's degree in Geographic Information Science offered in the Department of Geography and the Environment or Information and Communications Technology.

## Geographic Information Systems Outcomes

This program prepares students to do the following:

- Describe, analyze, and evaluate the nature of geographic data
- Compare, contrast, and apply appropriate applications of GIS technology to solve spatial problems
- Apply GIS technology to solve real-world problems
- Plan, implement, and execute a GIS project

## Certificate Admission

### Application Deadlines

- Fall 2018 Final Submission Deadline: July 20, 2018
- Fall 2018 Deadline for Applicants Educated Outside the U.S.: June 15, 2018
- Winter 2019 Final Submission Deadline: October 26, 2018
- Winter 2019 Deadline for Applicants Educated Outside the U.S.: September 28, 2018
- Spring 2019 Final Submission Deadline: February 8, 2019
- Spring 2019 Deadline for Applicants Educated Outside the U.S.: January 11, 2019
- Summer 2019 Final Submission Deadline: April 26, 2019
- Summer 2019 Deadline for Applicants Educated Outside the U.S.: March 29, 2019

### Admission Requirements

- **Online Admission Application**
- **\$50.00 Application Fee**
- **University Minimum Degree and GPA Requirements**
- **Transcripts:** (<http://bulletin.du.edu/graduate/admission-and-enrollment-policies/admission-process-and-standards-for-all-applicants/transcripts-and-proof-of-degree>) One official transcript from each post-secondary institution.
- **Résumé:** The résumé (or C.V.) should include work experience, research, and/or volunteer work.

## Admission Standards for Non-Native English Speakers

Official scores from the Test of English as a Foreign Language (TOEFL), International English Language Testing System (IELTS) or Cambridge English: Advanced (CAE) are required of all graduate applicants, regardless of citizenship status, whose native language is not English or who have been educated in countries where English is not the native language. The minimum TOEFL/IELTS/CAE test score requirements for the degree program are:

- **Minimum TOEFL Score (paper-based test):** 550
- **Minimum TOEFL Score (internet-based test):** 80 with minimum of 20 on each subscore
- **Minimum IELTS Score:** 6.5 with minimum of 6.0 on each band score
- **Minimum CAE Score:** 176 with minimum of 169 on each band score
- **English Conditional Admission Offered:** No, University College certificate programs do not offer English Conditional Admission.

Read the English Language Proficiency (<http://bulletin.du.edu/graduate/admission-and-enrollment-policies/additional-standards-for-non-native-english-speakers/english-language-proficiency-ielts-toefl>) policy for more details.

Read the English Conditional Admission (ECA) (<http://bulletin.du.edu/graduate/admission-and-enrollment-policies/additional-standards-for-non-native-english-speakers/english-conditional-admission-eca>) policy for more details.

Read the Required Tests for GTA Eligibility (<http://bulletin.du.edu/graduate/admission-and-enrollment-policies/additional-standards-for-non-native-english-speakers/required-tests-for-gta-eligibility>) policy for more details.

## Additional Standards for International Applicants

Per Student & Exchange Visitor Program (SEVP) regulation, international applicants must meet all standards for admission before an I-20 or DS-2019 is issued, [per U.S. Federal Register: 8 CFR § 214.3(k)] or is academically eligible for admission and is admitted [per 22 C.F.R. §62]. Read the Additional Standards For International Applicants (<http://bulletin.du.edu/graduate/admission-and-enrollment-policies/additional-standards-for-international-applicants>) policy for more details.

## Financial Aid

There are many different options available to finance your education. Most University of Denver graduate students are granted some type of financial support. Our Office of Financial Aid is committed to helping you explore your options.

# Certificate in Geographic Information Systems with a Concentration in Geographic Information Systems

## Program Requirements

Code	Title	Credits
<b>Core coursework requirements</b>		<b>8</b>
Complete the following two courses:		
GIS 4101	Introduction to Geographic Information Systems	
GIS 4504	Cartographic Design	
<b>Elective requirements (Choose four courses):</b>		<b>16</b>
GIS 4070	ArcObjects	
GIS 4080	Python Programming in GIS	
GIS 4110	Geographic Statistics	
GIS 4200	Geospatial Intelligence	
GIS 4510	GIS in Business	
GIS 4520	GIS in Telecommunications	
GIS 4530	Crime Mapping and Analysis	
GIS 4540	Conservation GIS	
GIS 4570	Geographic Information Systems in Public Health	
GIS 4620	Geodatabase Application	
GIS 4630	Public Domain Data for GIS	
GIS 4650	Demographic Analysis Using GIS	
GIS 4660	GIS in Municipal Government	
GIS 4670	GIS and the Law	
GIS 4680	Environmental Applications	
GIS 4683	GIS for Disaster Management	
GIS 4685	GIS and Natural Hazards	

GIS 4687	Hydrologic Modeling in GIS
GIS 4690	GPS for GIS
GIS 4700	Remote Sensing I
GIS 4701	Topics in Geographic Information Systems
GIS 4740	Remote Sensing II
GIS 4750	UAVs and GIS
GIS 4760	UAS Photogrammetry
GIS 4770	UAV Ground School Practical
GIS 4860	Internet Mapping
GIS 4980	Internship
GIS 4991	Independent Study
GIS 4992	Directed Study

**Total Credits**

24

### Minimum number of credits required for certificate: 24 credits

#### Courses

##### GIS 4070 ArcObjects (4 Credits)

This class is an introduction to the development of custom applications and tools in GIS. It combines ESRI's ArcObjects with C# .NET programming language to introduce students to desktop GIS development. Students learn about the C# language, Object Oriented Programming, ESRI's Object Model Diagrams, conversion of VBA code to C# code, the creation of custom GIS based forms, buttons, and tools, and the automation of the GIS workflow. Students leave this class with the ability to create embedded tools as well as distributable C# .NET GIS applications based on ArcGIS 10.

##### GIS 4080 Python Programming in GIS (4 Credits)

This course introduces Python concepts and the Python scripting environment in a GIS environment. Python is a free, open-source scripting language that has been integrated with ArcGIS. Python is a dynamic, interpreted language that can be used to automate redundant tasks and workflows in GIS. Students learn tools and techniques and proper Python syntax, script flow, and error handling. Students learn to write scripts that allow them to automate redundant tasks and workflows in GIS. Students learn to write scripts that allow them to automate geoprocessing processes and GIS work more efficiently. This course teaches fundamental concepts needed to create Python scripts in ArcGIS. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

##### GIS 4101 Introduction to Geographic Information Systems (4 Credits)

This is the initial course in Geographic Information Systems (GIS). General introduction including background, development, trends, prospects in this rapidly evolving technology; basic components, functions of GIS, fundamental spatial, geographic concepts explored through use of GIS software.

##### GIS 4110 Geographic Statistics (4 Credits)

This course introduces the basic concepts of probability and statistics with an emphasis on applications and an ongoing focus regarding the nature and problems associated with spatial or geographic data. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

##### GIS 4200 Geospatial Intelligence (4 Credits)

The term geospatial intelligence (GEOINT) means the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the earth. GEOINT consists of imagery, imagery intelligence and geospatial information. This course serves as an introduction to the fundamentals of the geospatial intelligence community, core GEOINT technologies and operations, and the role of GEOINT in national, regional and local security affairs supporting decision makers and operations. The course is built on a framework of data, technology and analysis in support of the GEOINT community which may include natural disasters, first responders, military problems, homeland defense, and law enforcement. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

##### GIS 4504 Cartographic Design (4 Credits)

The theory and art of map making developed over several thousand years and has recently been revolutionized by computer technology. This course is designed to expose students to the use of computer techniques in assessing technical design issues in the compilation of accurate and meaningful automated geographic mapping products. ArcView is used in a series of hands-on lab exercises to produce typical GIS mapping products. Each class includes lecture and discussion of cartographic design concepts. Emphasis is placed on reader perception of map design elements, and also includes an introduction to appropriate software tools and application of concepts through lab exercises. In-class time is provided for work on lab exercises. It is likely that additional lab time outside of class will be necessary and/or valuable for students, particularly in completion of the final project. Prerequisite: GIS 4101.

##### GIS 4510 GIS in Business (4 Credits)

Businesses continue to embrace GIS as an effective alternative to traditional manual mapping analysis methods. GIS has emerged as an affordable solution for performing essential revenue producing and expense reducing functions. Many years ago, successful GIS implementation required huge capital investment and a large staff of GIS experts; however, with the introduction of more powerful inexpensive computers and easier to use software, companies of all sizes are unleashing the business potential of GIS on the marketplace. This course exposes students to various business applications and uses of GIS as well as the underlying theories and technology behind the applications. This course emphasizes various business disciplines including Marketing, Real Estate, Transportation, and Oil & Gas using ArcView GIS in practical, hands-on exercises that demonstrate the theories and concepts discussed in the lectures. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4520 GIS in Telecommunications (4 Credits)**

Telecommunications is a thriving technology and business, accounting for a significant percentage of technical advances and revenue around the globe. GIS has emerged as a crucial tool in the telecommunications field for maintaining existing entities, planning for additional ones, and for gaining an advantage in this very competitive marketplace. The use of GIS in the telecom industry continues to grow because GIS technology accommodates the many CAD programs and drawings representing plant and transmission towers/coverage as well as the geographic representations of those items. Only a few years ago, introducing GIS into a telecom business required significant cash outlay, but through less expensive hardware and more user-friendly software, now even a modest CLEC can implement an effective GIS. This course exposes students to the various applications and uses for GIS in the telecom arena by breaking down the miscellaneous telecom requirements into GIS components and technological solutions. This course emphasizes specific telecom technology application requirements and allows students, through hands-on-lab work, to discover the power of GIS in delivering superior telecom solutions. This course also focuses on OSP/ISP applications and solutions, network connectivity issues as well as the exploding future of wireless technology. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4530 Crime Mapping and Analysis (4 Credits)**

Municipal police departments, county sheriff departments, and other state and federal law enforcement agencies use GIS technology as a tool to analyze crime statistics and patterns. This course explores how GIS technology is used in law enforcement to provide strategic, tactical, and administrative crime analysis. Prerequisite: GIS 4504 or similar GIS course and/or work experience.

**GIS 4540 Conservation GIS (4 Credits)**

This course is designed to provide students with an introduction to the use of geographic information systems (GIS) in conservation. Students receive an introduction to the use of GIS in various types of conservation studies and preservation. Emphasis is placed on the types of applications and analytical techniques in environmental fields where GIS is commonly used as a mapping and analytical tool. The analytical techniques used in lab exercises consist of practical applications that support planning and management of land, species, and habitats. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4570 Geographic Information Systems in Public Health (4 Credits)**

GIS offers many applications and functionality that are tremendously beneficial to the Public Health industry. The ability to visualize cases in space (geographically) and time is invaluable in analyzing spatial clusters of health related events. Further the ability to model the spread of a potential epidemic can literally be a life saver. GIS is a natural choice for solving many Public Health issues including: analyzing the location of diseases; the spread of contagious diseases (both vector borne as well as the spread through human contact); the cause and effect of environmental factors; as well as the availability of Health facilities. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4620 Geodatabase Application (4 Credits)**

This course in Geodatabase Application is logically broken into two separate component parts; the first section deals with Geodatabase concepts and provides a general overview of the Geodatabase structure and implementation including; background, object classes, feature classes, relationship classes, domains, validation rules, and Geodatabase topology. The second portion of the course focuses on Geodatabase Application introducing advanced features of Geodatabase, providing a solid foundation for the application of the Geodatabase to model and address complex real world issues. Geodatabase Linear Referencing, Geodatabase Surface Modeling, and Geocoding Services in the Geodatabase, are explored. This course incorporates a hands-on lab component. Computer lab exercises are designed to introduce the student to concepts and Geodatabase application. Strong emphasis is placed on Geodatabase design. Design objectives, design guidelines and functional requirements of the resulting Geodatabase model are addressed. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4630 Public Domain Data for GIS (4 Credits)**

Geospatial data are the foundation upon which GIS and spatial analysis rests. As GIS has matured, the challenge has evolved from generating data to managing the enormous volume of data from government agencies, nonprofit organizations, and industry, and increasingly, from ordinary citizens through citizen science and volunteered geographic information efforts. Key to working with this volume of data are essential issues such as privacy, copyright, public domain, cost recovery, metadata standards, and data quality that GIS professionals must grapple with to be effective in the 21st Century. This class discusses and applies these issues and works with a rich array of data sources to enable effective decision-making in a Geographic Information System. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4650 Demographic Analysis Using GIS (4 Credits)**

This course offers an overview of US Decennial Census data, covering a brief historical overview of why census information is collected, collection procedures, geographic coverage, and subject matter contained in census reports. Using a popular PC-based desktop mapping software program, students learn how to navigate through census files and create a variety of thematic maps. Several application areas, such as marketing, demographic analysis and facility planning, are used in sample exercises. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4660 GIS in Municipal Government (4 Credits)**

There are many areas of government where desktop mapping can be extremely helpful in solving problems that are spatial in nature. This course explores the many types of data collected by city and county government agencies from crime and election data to building, assessment, and zoning data and how it can be displayed in map form. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4670 GIS and the Law (4 Credits)**

This course explores the legal and technical ramifications created by Geographic Information Systems (GIS), Mobility and the Law, including the legal and policy issues related to the science of GIS, the sharing of geographic information, the data generated by mobile devices, the intellectual property issues, security and privacy issues, business and contractual issues related to GIS, and the standards of care and liability related to GIS. This course also examines the types of issues and concerns that exist in the U.S. and the world created by geographic information science and the mobile device. The evolution of GIS and the mobile device directly impacts governments, companies, and individuals on a daily basis. In today's world, more than three billion people have smart phones in their hands constantly. This creates issues about how to handle data, security and privacy, civil and criminal laws, rules and regulations, contractual agreements, and service-level agreements between parties on many levels from service providers in different states, countries and parts of the world. All of these issues need to be balanced by the differing cultural standards and mores from all over the world and legal (and sometimes not so legal) methods of protecting governments and companies in this ever-changing "always-connected" world created by GIS and the mobile device. Prerequisite: GIS 4101 - Intro to GIS, and GIS 4700 - Remote Sensing I and/or similar GIS course and/or work experience.

**GIS 4680 Environmental Applications (4 Credits)**

This class provides students with an introduction to practical applications of computerized Geographic Information Systems (GIS) in environmental assessment and natural resource management. Emphasis is placed on automated analytical techniques and data presentation methods that support facility site selection, environmental impact analyses, resource management, and characterization of environmental hazards. This course is designed to provide students who participate in environmental assessment projects with introductory preparation for practice as GIS professionals in public agencies or in the private sector. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4683 GIS for Disaster Management (4 Credits)**

This course serves as an introduction to Geographic Information Systems and their application in Emergency Operations. The basic concepts of geography, cartography and Global Positioning Systems will be covered, along with the basic components and capabilities of a geographic information system. Students will learn about the fundamental types of GIS analysis and applications, focusing on those used in Emergency Operations. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4685 GIS and Natural Hazards (4 Credits)**

This course is designed to provide students with an introduction to the use of GIS in natural hazard assessment. Students receive an introduction to the use of geographical information systems (GIS) in various types of natural disasters and response management. Emphasis is placed on the types of applications and analytical techniques in environmental fields where GIS is commonly used as a mapping and analytical tool. The analytical techniques used in lab exercises consist of practical applications that support hazard risk and assessment, mitigation, and emergency response planning. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4687 Hydrologic Modeling in GIS (4 Credits)**

Hydrology is concerned with movement of the earth's waters through the hydrologic cycle, and the transport of constituents carried in its flow. In GIS, the landscape is represented by means of geographically referenced data describing the character and shape of relief features. A spatial hydrology model simulates the water flow and transport in a specific locale using GIS data structures. Hydrologic modeling in GIS allows us to automatically delineate a drainage system and quantify the characteristics of the system. It focuses on the movement of water across a land surface. This course looks at the basic inputs to hydrological modeling in GIS, walks students through established modeling procedures, and has students work on projects that are real and relevant as model applications. Instruction is largely hands-on, project-oriented. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4690 GPS for GIS (4 Credits)**

This course is an introduction to GPS (Global Positioning Systems) concepts, techniques, and applications as they relate to GIS data collection. Lectures focus on satellite surveying, GPS technology, error sources, program planning, data collection design, and Quality Control and Quality Assurance issues for data collection programs. Lab exercises include planning a GPS survey, designing a field data collection plan and associated data dictionary, field data collection, and data integration into a GIS. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4700 Remote Sensing I (4 Credits)**

This course provides a survey of remote sensing technologies, applications, and the industry. This course is designed for GIS, Geography and Geoscience students who seek to broaden their understanding of remote sensing in support of Geographic Information Systems. Introductions to the electromagnetic spectrum, energy sources, radiation principles, aerial cameras, and electronic imaging provide the student with the initial building blocks to a thorough understanding of remote sensing. This course provides an overview of the various high altitude and space-based collection systems and their characteristics, with a view toward future systems and capabilities. In addition, this course exposes students to the techniques of extracting relevant information from both hard copy and digital imagery. Pre-requisite: This course is a pre-requisite for GIS 4740 – Remote Sensing II.

**GIS 4701 Topics in Geographic Information Systems (2-5 Credits)**

The content of this course varies each time it is offered, depending on the interests and needs of the students. Each time the course is offered, the specific content is announced in the quarterly course schedule. Depending on the subject matter, students may be required to have completed prerequisite courses.

**GIS 4740 Remote Sensing II (4 Credits)**

This course is the second in the two-course Remote Sensing emphasis of University College's GIS Certificate Program. The curriculum is a rigorous presentation of digital imaging processing theory with emphasis on its application to airborne and space borne imagery. The course includes computer laboratory exercises and workshops, where the students apply theory to satellite and air photo data. Interpretation of the digitally processed data is also included in the class exercises. Examples of vector and raster data integration are shown as well. Prerequisite: GIS 4700.

**GIS 4750 UAVs and GIS (4 Credits)**

The purpose of this course is to introduce GIS students to the emerging world of using Unmanned Aerial Vehicles (UAV) in the GIS workplace for data collection, reconnaissance, and research. UAVs are in the news every day, highlighting their use in a military context. Soon the Federal Aviation Administration (FAA) will release new rules and regulations governing the use of UAVs in the civilian sector. This course will prepare students to be conversant in the world of UAVs, basic aviation, safety, flying, mission planning, and general data gathering techniques for use in GIS. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4760 UAS Photogrammetry (4 Credits)**

Surveying, photogrammetric mapping, GPS, and remote sensing are critical components to working in the UAV and GIS domain. The second course in this two-course sequence will expand on the data collection process highlighted in the first class and deliver the foundations required by GIS professionals working with UAVs. Prerequisite: GIS 4101 or similar GIS course and/or work experience and GIS 4750-UAVS and GIS.

**GIS 4770 UAV Ground School Practical (4 Credits)**

Course Description: The purpose of this course is to provide skills and abilities to become a remote pilot in command (RPIC) within the United States. The class content will focus on 14 CFR 107, the rules and regulations that allow RPICs to operate unmanned aircraft vehicles (UAVs) safely and legally. In addition, students will be given hands-on training in the best practices for flying UAVs. Course Overview/Purpose: The release of 14 CRF 107 by the FAA has set a legal framework for commercial UAVs operations in the United States. The purpose of this course is to help students become well versed in 107 and gain hands-on experience operating UAVs. Students will become proficient with UAV aeronautical operation standards, discover the rules and regulations of airspace that all RPICs must comply with, and evaluate the effects that weather has on UAVs as well as sources of weather information. Students will also assess the performance abilities and limitations of UAVs and explore standard UAV operations as outlined in the 107 regulations. Prerequisite: GIS 4101 or similar GIS course and/or work experience.

**GIS 4860 Internet Mapping (4 Credits)**

Creating web-based maps allows city and local governments, businesses, and other organizations to publish, discover, and share geospatial information. This course introduces the fundamentals of various web-based mapping systems and software applications. Students complete comprehensive projects, each resulting in the creation of a working web site using different technologies. Students make use of WMS (Web Map Services) and WFS (Web Feature Services), integrating them into their web sites and creating their own web map service. Prerequisite: GIS 4101 and GIS 4504 or similar GIS course and/or work experience.

**GIS 4980 Internship (1-4 Credits)**

GIS students may fulfill up to four quarter hours of electives by enrolling in a GIS internship with a GIS company or an agency actively engaged in GIS activities. Students incorporating professional work experience must work with an approved mentor, who evaluates the student's performance and learning. The internship is designed to provide practical experience to students without prior professional experience in the field. Students who are employed on a full-time basis in the GIS industry may not use paid work experience as part of the academic program.

**GIS 4991 Independent Study (1-8 Credits)**

This is an advanced course for students wishing to pursue an independent course of study. The student must be accepted in a degree program, have earned a grade point average of 3.0 or better, obtained the approval of the department director, and have completed the Independent Study form and filed the form with all appropriate offices before registering for the independent study. Independent Study is offered only on a for-credit basis.

**GIS 4992 Directed Study (1-8 Credits)**

This is an advanced course for students wishing to pursue a directed course of study. The student must be accepted in a degree program, have earned a grade point average of 3.0 or better, obtained the approval of the department director, and have completed the Independent Study form and filed the form with all appropriate offices before registering for the directed study. Directed Study is offered only on a for-credit basis.