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 problems related to GIS.

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

Admission Criteria

A regionally accredited baccalaureate degree is required for admission. Applicants must have a minimum grade point average (GPA) of 3.0 on a 4.0 scale (or equivalent) in their undergraduate work from a regionally accredited degree-granting institution for full admission. Applicants whom University College believes may successfully engage in graduate work, but who have not met the previously stated GPA requirement, may be admitted to a degree program on a provisional basis. The GMAT and GRE are NOT required.

Admission Process

Certificate applications are reviewed for admission on a quarterly basis. Applications and all supplemental materials must be submitted online; with the exception of transcripts, which must be received by the stated application deadline (requests for accommodation may be granted). Applicants will be notified of a decision via email and standard mail approximately two weeks following the application deadline. Detailed application information and application deadlines are located on the University College website (http://universitycollege.du.edu/answers/admission/certificate.cfm).

- **Application**: Applicants must complete the application online (https://gradadmissions.du.edu/apply).
- **Application Fee**: A $50 non-refundable application fee is required for an application to be processed.
- **One Official Transcript from each Post-Secondary Institution**: Applicants are required to submit an official transcript from each post-secondary institution they have attended, or are presently attending, where 2 quarter hours (or one semester hour) or more were completed. This includes transcripts for credit earned as transfer work and study abroad.
- **Résumé/Curriculum Vitae (CV)**.
- **Certificate Plan**: The certificate plan, detailing courses for the academic program, is required to complete the admission process and can be completed through the University College online Degree Builder (http://universitycollege.du.edu/DegreeBuilder/Student/ChooseDegree.aspx) tool.
- **Language Proficiency**: Applicants whose native language is not English or who have been educated in countries where English is not the native language, regardless of citizenship, must provide official scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS). The TOEFL and IELTS scores are valid for two years from the test date. Applicants may be exempt from
English proficiency test requirements if they have earned a post-secondary degree from a recognized/accredited university where the language of instruction and examination is English.

- **Proof of Permanent Residency:** Permanent Residents must provide a copy of their Registration Alien Card (green card).
- **Admission Interview:** An interview may be required at the program director's request.
- **International Applicants:** Additional requirements are listed below for international applicants.

## International Admission
International applicants must comply with all requirements set forth for domestic applicants and supplement their application with additional documentation. International applicant information, including admission deadlines and the International Applicant Checklist, is available on the University College website (http://universitycollege.du.edu/answers/admission/international.cfm).

Admitted international applicants whose native language is not English are required to attend University College’s International Preparation Week (http://universitycollege.du.edu/answers/admission/international.cfm) prior to attending courses at University College.

University College will consider graduate applicants who have earned three-year baccalaureate degrees from 15-year education systems. The school from which the applicant has earned the degree must be a formally recognized or regionally accredited institution of higher learning, as determined by the University Of Denver Office Of International Student Admission. Admission policy and procedures for applicants holding three-year baccalaureate degrees is the same as for other international applicants with one exception: applicants with a three-year degree are not eligible for English Conditional Admission. Priority consideration will be given to those with a minimum of three year’s work experience.

### Additional Admission Requirements for International Applicants

- **English Proficiency:** All internationally educated applicants whose native language is not English are required to submit proof of English Language Proficiency regardless of citizenship and/or U.S. residency.

  1. **TOEFL:** A minimum score of 550 (paper based), 213 (computer based), or 80 (Internet based) is required for admission consideration. Generally, applicants should achieve at least 20 in all TOEFL subscores on the internet-based exam. TOEFL score reports older than two years from the date of application are not acceptable for admission consideration.

  2. **Academic IELTS:** A score of 6.5 or higher is required to be considered for admission. Each individual band score must be 6.0 or higher. IELTS score reports older than two years from the date of application are not acceptable for admission consideration.

  3. **Possible Exemptions:** International applicants may be exempt from the TOEFL/Academic IELTS requirement if by the time of matriculation they have earned a post-secondary degree from a formally recognized/accredited university where the entire language of instruction and examination is in English.

  4. **English Conditional Acceptance (ECA):** Master's degree applicants who do not meet the required level of English proficiency may be considered for conditional acceptance if all other admission criteria are met. Prior to enrolling in any graduate-level coursework, ECA requires an evaluation by the University of Denver’s English Language Center (ELC) and successful completion of intensive ELC English courses including the Graduate Preparation Program. Academic classes may not be taken while students are enrolled at the English Language Center. Graduate certificate students may not be admitted through ECA. As an alternative to the English Language Center, an applicant may become fully admitted by submitting sufficient TOEFL/Academic IELTS scores.

- **Official Transcripts and Translations:** International applicants should submit official transcripts printed in the official language of instruction of their institution. Certified English translations must accompany all transcripts except for those provided by institutions that issue documents in English.

- ** Photocopy of Diploma/Degree Certification and Appropriate Translations:** Applicants who have earned a degree outside the U.S. must submit proof of graduation through a degree certificate or diploma along with all appropriate official translations.

- **A Photocopy of Current Passport:** Applicants must provide a copy of the photograph and legal name page of their passport. This is required before an I-20 can be issued by the University of Denver.

- **The Supplemental Information Form (SEVIS Supplement):** Applicants who are not U.S. Citizens or permanent residents must complete the SEVIS form.

- **Financial Verification Form:** Applicants seeking an I-20 student visa must submit financial verification documents.

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

### Program Requirements

#### Core coursework requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>GIS 4101</td>
<td>Introduction to Geographic Information Systems</td>
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<tr>
<td>GIS 4504</td>
<td>Cartographic Design</td>
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</tbody>
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#### Elective requirements (Choose four courses):

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<td>GIS 4070</td>
<td>ArcObjects</td>
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<td>GIS 4080</td>
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<td>GIS 4520</td>
<td>GIS in Telecommunications</td>
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<td>GIS 4530</td>
<td>Crime Mapping and Analysis</td>
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<td>GIS 4540</td>
<td>Conservation GIS</td>
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<tr>
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<td>Demographic Analysis Using GIS</td>
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<tr>
<td>GIS 4670</td>
<td>GIS and the Law</td>
</tr>
<tr>
<td>GIS 4680</td>
<td>Environmental Applications</td>
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<tr>
<td>GIS 4685</td>
<td>GIS and Natural Hazards</td>
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<td>GIS 4687</td>
<td>Hydrologic Modeling in GIS</td>
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<tr>
<td>GIS 4690</td>
<td>GPS for GIS</td>
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<tr>
<td>GIS 4700</td>
<td>Remote Sensing</td>
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<tr>
<td>GIS 4701</td>
<td>Topics in Geographic Information Systems</td>
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<td>GIS 4740</td>
<td>Digital Image Processing</td>
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<td>GIS 4750</td>
<td>UAVs and GIS</td>
</tr>
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<td>GIS 4760</td>
<td>UAS Photogrammetry</td>
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<td>GIS 4860</td>
<td>Internet Mapping</td>
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<td>GIS 4980</td>
<td>Internship</td>
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<tr>
<td>GIS 4991</td>
<td>Independent Study</td>
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<tr>
<td>GIS 4992</td>
<td>Directed Study</td>
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**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 (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 teaching 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.

**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.
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.

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.

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.

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.

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.

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.

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.
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.

GIS 4670 GIS and the Law (4 Credits)
This course provides an overview, from a legal perspective of the role of government in handling and disseminating GIS data; an explanation and analysis of state and federal legislation and court decisions regarding open-records laws; and, an explanation and analysis of other laws or legal doctrines that affect GIS such as copyright, contract, right of privacy, anti-trust, tort liability and ethics.

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.

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.

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.

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.

GIS 4700 Remote Sensing (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.

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 Digital Image Processing (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 be shown as well.

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-Introduction to GIS.
**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 4750-UAVS and GIS.

**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.

**GIS 4980 Internship (4 Credits)**
GIS students may fulfill up to three 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.