Geographic Information Science

Department Website: https://voices.uchicago.edu/giscience (https://voices.uchicago.edu/giscience/)

Program of Study

Spatial thinking deals with the fundamental role of space, place, location, distance, and interaction—crucial to tackling many research questions in the social and physical sciences. The minor in geographic information science provides a coherent exposure to rigorous spatial thinking and its expression through the theories and methods of geographic information science.

Geographic information science covers all aspects pertaining to accessing, storing, transforming, manipulating, visualizing, exploring, and reasoning about information where the locational component is important (spatial data). This includes the technical and computational aspects of geographic information systems, the methodologies of spatial analysis and spatial statistics, mapping, and geo-visualization, as well as societal aspects related to the use of geographic data.

The minor serves as a complement to other majors, such as computer science, statistics, economics, public policy studies, sociology, anthropology, political science, or environmental and urban studies, but would also be of value to majors in the humanities and physical sciences interested in the spatial aspects of their field.

Program Requirements for the Minor

The minor consists of six courses: two prerequisites, three core methods courses, and one elective from a series of offerings. The core methods courses provide a coherent exposure to rigorous spatial thinking and its incorporation into the methodologies of geographic information systems, spatial analysis, and spatial data science.

The electives consist of courses that touch upon various aspects of spatial thinking, with different degrees of technical materials, and are intended to either act as "gateways" into the minor or to provide the opportunity for the application of spatial analysis in a range of fields.

GISC 28400 GIScience Practicum serves as an optional capstone course for the minor. In the course, students will develop a multifaceted GIS project incorporating spatial thinking in design, infrastructure, and implementation. Projects could include the development of a web application, dynamic dashboard, interactive storytelling map, infographic-driven policy brief, or research article and can be carried out in conjunction with a thesis requirement of the student's major.

Summary of Requirements: Minor in Geographic Information Science

STAT 22000	Statistical Methods and Applications (or equivalent) *	100
or DATA 11800	Introduction to Data Science I	
GISC 28702	Introduction to GIS and Spatial Analysis (or equivalent introductory GIS course (by petition))	100
Three core methods courses from the approved list		300
Any elective from the list of courses below		100
Total Units		600

* Students who take STAT 22000 or DATA 11800 to satisfy a major requirement will complete a five-course (500-unit) minor.

Core Methods Options for the Minor in Geographic Information Science

Three of the following courses must be taken to fulfill the core methods requirement for the minor in geographic information science.

GISC 20500	Introduction to Spatial Data Science	100
GISC 27100	Cartographic Design and Geovisualization	100
GISC 28100	Introduction to Geocomputation	100
GISC 28200	Spatial Analysis Methods in Geographic Information Systems	100
GISC 28300	Topics in Geographic Information Science	100
GISC 28400	GIScience Practicum	100

Elective Options for the Minor in Geographic Information Science

A fourth core methods course or one of the following courses may be taken to fulfill the elective course option for the minor in geographic information science. Course availability varies by year.

GISC 20061	Ancient Landscapes I	100
GISC 20062	Ancient Landscapes II	100
GISC 20273	Urban Spatial Archaeology I	100

GISC 20519	Spatial Cluster Analysis	100
GISC 20559	Spatial Regression Analysis	100
GISC 25900	Introduction to Location Analysis	100
GISC 27102	Spatial and Environmental Cognition	100
GISC 27104	Movement Data and Analysis	100
GISC 27105	Web Mapping	100
GISC 27110	Spatial Thinking in Historical Cartography	100
GISC 28700	Readings in Spatial Analysis	100
GISC 28800	History of Cartography	100

Advising and Grading

Courses in the minor may not be double-counted with the student's major(s), other minors, or general education requirements.

Courses in the minor must be taken for quality grades, and more than half of the requirements for the minor must be met by registering for courses bearing University of Chicago course numbers.

Students who elect the minor must confer with the program before the end of Spring Quarter of their third year to declare their intention to complete the minor. The director's approval for the minor program should be submitted to the student's College adviser by the deadline above using the Consent to Complete a Minor Program (https://humanities-web.s3.us-east-2.amazonaws.com/college-prod/s3fs-public/documents/Consent_Minor_Program.pdf) form.

Students may petition the program to have a course counted as an elective that is not included on the current list of electives.

Geographic Information Science Courses

GISC 20061. Ancient Landscapes I. 100 Units.
This is a two-course sequence that introduces students to theory and method in landscape studies and the use of Geographical Information Systems (GIS) to analyze archaeological, anthropological, historical, and environmental data. Course one covers the theoretical and methodological background necessary to understand spatial approaches to landscape and the fundamentals of using ESRI's ArcGIS software, and further guides students in developing a research proposal. Course two covers more advanced GIS-based analysis (using vector, raster, and satellite remote sensing data) and guides students in carrying out their own spatial research project. In both courses, techniques are introduced through the discussion of case studies (focused on the archaeology of the Middle East) and through demonstration of software skills. During supervised laboratory times, the various techniques and analyses covered will be applied to sample archaeological data and also to data from a region/topic chosen by the student.
Instructor(s): Mehrnoush Soroush Terms Offered: Autumn
Equivalent Course(s): GISC 30061, ANTH 36710, ANTH 26710, NEAA 30061, NEAA 20061, CEGU 30061, CEGU 20061

GISC 20062. Ancient Landscapes II. 100 Units.
This is a two-course sequence that introduces students to theory and method in landscape studies and the use of Geographical Information Systems (GIS) to analyze archaeological, anthropological, historical, and environmental data. Course one covers the theoretical and methodological background necessary to understand spatial approaches to landscape and the fundamentals of using ESRI's ArcGIS software, and further guides students in developing a research proposal. Course two covers more advanced GIS-based analysis (using vector, raster, and satellite remote sensing data) and guides students in carrying out their own spatial research project. In both courses, techniques are introduced through the discussion of case studies (focused on the archaeology of the Middle East) and through demonstration of software skills. During supervised laboratory times, the various techniques and analyses covered will be applied to sample archaeological data and also to data from a region/topic chosen by the student.
Instructor(s): Mehrnoush Soroush Terms Offered: Winter
Prerequisite(s): NEAA 20061
Equivalent Course(s): ANTH 26711, CEGU 30062, CEGU 20062, NEAA 30062, ANTH 36711, NEAA 20062, GISC 30062

GISC 24100. Satellite Image Analysis. 100 Units.
This course takes students to the next level of remote sensing methods and image analysis, focusing on advanced quantitative theories and methods for analyzing satellite imagery. Students will explore a range of satellite missions, with an emphasis on using Landsat and Sentinel satellite images. Through analysis in QGIS and GDAL, they will learn to perform band combinations, create indices such as the Burn Ratio and NDVI, and carry out image segmentation and classification. By the end of the course, students will have a solid understanding of advanced satellite image analysis techniques and their applications in various domains, including environmental monitoring, disaster management, and land-use planning.
Instructor(s): Sperone, Gianluca Terms Offered: Autumn

Equivalent Course(s): GISC 34100

GISC 24600. Introduction to Urban Sciences. 100 Units.
This course is a grand tour of conceptual frameworks, general phenomena, emerging data and policy applications that define a growing scientific integrated understanding of cities and urbanization. It starts with a general outlook of current worldwide explosive urbanization and associated changes in social, economic and environmental indicators. It then introduces a number of historical models, from sociology, economics and geography that have been proposed to understand how cities operate. We will discuss how these and other facets of cities can be integrated as dynamical complex systems and derive their general characteristics as social networks embedded in structured physical spaces. Resulting general properties of cities will be illustrated in different geographic and historical contexts, including an understanding of urban resource flows, emergent institutions and the division of labor and knowledge as drivers of innovation and economic growth. The second part of the course will deal with issues of inequality, heterogeneity and (sustainable) growth in cities. We will explore how these features of cities present different realities and opportunities to different individuals and how these appear as spatially concentrated (dis)advantage that shape people's life courses. We will show how issues of inequality also have consequences at more macroscopic levels and derive the general features of population and economic growth for systems of cities and nations.
Instructor(s): Luis Bettencourt Terms Offered: Autumn
Prerequisite(s): STAT 22000
Equivalent Course(s): GISC 34600, PBPL 24605, SOCI 20285, CEGU 24600

GISC 24800. Introduction to Remote Sensing Analysis. 100 Units.
Remote sensing is the process of taking measurements of the earth's surface through sensors such as satellites or drones. The analysis of remote sensing data helps address critical challenges in areas like natural resource modeling and socio-economic or environmental analysis, such as responding to natural disasters, measuring urbanization through night lights, or tracking deforestation. This course introduces concepts and methods for visualizing, processing, and analyzing remotely sensed data. It covers topics such as sources and types of data, data access and management, image interpretation, and modeling. Students will gain experience applying these techniques to real-world scenarios. By the end of the course, they will have a solid foundation in remote sensing analysis, equipping them with skills for research and work in fields such as urban development, conservation, and resource management.
Instructor(s): TBA Terms Offered: Autumn
Prerequisite(s): None
Equivalent Course(s): GISC 34800

GISC 24900. Digital Elevation Modeling and Analysis. 100 Units.
The course will guide students through various methods of remote sensing data collection and analysis, focusing on global phenomena occurring on land, oceans, and the lower atmosphere, such as those captured by the NASA-MODIS Aqua and Terra satellites. Students will gain experience with the USGS 3D Elevation Program and airborne topographic LiDAR and learn how to create detailed elevation models to address quantitative GIS problems. Additionally, students will enhance their skills in geospatial analysis and remote sensing technologies QGIS or GDAL. Through a combination of theoretical knowledge and exercises, this course will equip them with the expertise required to tackle real-world problems in environmental monitoring, urban planning, and other fields reliant on accurate geospatial data.
Instructor(s): Sperone, Gianluca Terms Offered: Autumn
Equivalent Course(s): GISC 34900

GISC 25900. Introduction to Location Analysis. 100 Units.
Optimizing the location of facilities and services - agricultural, industrial, retail, and knowledge-based - has long been a focus for geographers, regional scientists, and urban planners. This course covers several foundational location problems in economic geography and urban planning, such as: covering problems, center problems, median problems, and fix charge facility location problems. This course incorporates several GIS exercises to teach students the basic principles of spatial optimization and to help illuminate the foundational theoretical principles of location modeling.
Instructor(s): Yue Lin Terms Offered: Winter. Offered 2024–25
Equivalent Course(s): GISC 35900, CEGU 25900

GISC 27100. Cartographic Design and Geovisualization. 100 Units.
This course is a hands-on introduction to core principles and techniques associated with cartographic design, especially with regards to digital map design and the geographic visualization of data. In this course, you will work with free and open-source geographic data visualization and Geographic Information Systems (GIS) software and tools, presenting your design assignments in class for student-led peer critiques, culminating in a final design portfolio at the end of the course. You will also conduct personal field investigations throughout the quarter to apply your learning and gain real world inspiration. Main topics include map generalization, symbology, scale, visual variables, scales of measurement, 2D and 3D design, map animation and interaction, and web mapping. The course is a survey course of these topics, with opportunities to actively build your design skills and critical evaluation abilities with regards to cartography and geographic visualization.
Instructor(s): Crystal Bae Terms Offered: Autumn. Offered 2024–25
Equivalent Course(s): CHST 27100, GISC 37100, CEGU 27100

GISC 27102. Spatial and Environmental Cognition. 100 Units.
This course serves as an overview of spatial cognition and environmental perception, which relates to all aspects of spatial thinking, spatial behavior, and human-environment interaction in spatial and social contexts. Topics of study include cognitive maps and wayfinding behavior, spatial and environmental learning, spatial choice and decision-making, migration and travel, time geography, place and regional identity, and the role of gender and culture in spatial cognition.
Instructor(s): Crystal Bae Terms Offered: Spring. Offered 2023-24
Equivalent Course(s): GISC 37102, CHST 27102, CEGU 27102

GISC 27104. Movement Data and Analysis. 100 Units.
This is a methodological course overviewing movement data types, common data sources and applications, movement representations and scale, movement parameters, 2D and 3D representations of movement, and types of visualization approaches (trajectories, flow maps, network-based). The topics covered draw from application areas in human transportation, temporary travel and migration, and non-human animal movement.
Instructor(s): Crystal Bae Terms Offered: Winter. Offered 2024-25
Equivalent Course(s): GISC 37104

GISC 27105. Web Mapping. 100 Units.
This applied course in geographic information science builds upon and refines knowledge and geocomputational expertise gained in the GIScience sequence. Students will develop a multifaceted GIS project incorporating spatial thinking in design, infrastructure, and implementation. The 2024 Practicum will emphasize urban renewal in the mid-20th century, specifically Chicago during the 1960s. Students will conduct guided projects investigating the implications and legacies of urban renewal, utilizing spatial analysis methods such as network analysis, accessibility analysis, machine learning, and/or regression modeling. This course will feature guest lectures from organizations such as the Chicago History Museum and Preservation Chicago to introduce stories and backgrounds of urban renewal in the United States. Students will also have the opportunity to present their work at an event in collaboration with the Chicago History Museum.
Instructor(s): Robert Shepard Terms Offered: Spring 2023-24
Prerequisite(s): GISC 28702 Introduction to GIS & Spatial Analysis, GISC 20500 Introduction to Spatial Data Science, or equivalent training in GIS is strongly recommended
Equivalent Course(s): GISC 37105

GISC 27106. Geospatial Data Science for Urban Applications. 100 Units.
During the middle decades of the 20th century, government-backed demolition occurred under a variety of housing and transportation programs, often referred to under the heading "urban renewal." Significant scholarship in sociology, economics and urban studies has explored the theoretical implications of this tumultuous period. This course will compliment this theoretical background by offering a hands-on learning experience in which students will digitally recreate what was lost during the urban renewal period. The course will offer students practical experience in utilizing geospatial techniques to tackle real-world urban challenges. Through a hands-on approach, participants will learn to use machine learning tools to digitally reconstruct historic places.
Instructor(s): Yue Lin Terms Offered: Autumn. Offered 2024–25
Equivalent Course(s): GISC 37106

GISC 27107. Spatial Reasoning & Pitfalls. 100 Units.
TBD
Instructor(s): Shepard, Rob Terms Offered: Spring 2024–25

GISC 27110. Spatial Thinking in Historical Cartography. 100 Units.
The course will introduce students to the ways in which cartographers in the English-speaking world have conceived of representing spatial patterns in map form, and how that has changed over time beginning in the 18th century, given changes in world view, cultural background, cartographic technology, business organization, and educational fashion. The objective is to sharpen students' ability to think critically about how maps have been produced in history, evaluate their design, effectiveness, and limitations, and the uses to which they have been put.
Instructor(s): M. Conzen Terms Offered: Autumn
Note(s): This course can be counted toward as a 4th year CEGU/ENST Capstone course.
Equivalent Course(s): CHST 27110, CEGU 27110

GISC 27155. Urban Design with Nature. 100 Units.
This course will use the Chicago region as the setting to evaluate the social, environmental, and economic effects of alternative forms of human settlement. Students will examine the history, theory and practice of designing cities in sustainable ways - i.e., human settlements that are socially just, economically viable, and environmentally sound. Students will explore the literature on sustainable urban design from a variety of perspectives, and then focus on how sustainability theories play out in the Chicago region. How can Chicago's neighborhoods be designed to promote environmental, social, and economic sustainability goals? This course is part of the College Course Cluster program: Urban Design. In Autumn 2025, Urban Design with Nature will focus on sustainable and accessible mobility with a focus on campus and the neighborhoods we transverse and inhabit. Students will consider how mobility is central to urban sustainability and how to reimagine cities, neighborhoods and campuses as social and economic spaces connected by safe, low impact, environmental,

equitable and efficient networks of transit. Students enrolled in Autumn 2025 must be willing to spend time outdoors, moving about campus and its surroundings.
Instructor(s): Sabina Shaikh and Emily Talen Terms Offered: Autumn
Equivalent Course(s): CEGU 27155, ARCH 27155, PBPL 27156, CCSG 22502, CEGU 37155, CHST 27155, BPRO 27155

GISC 28100. Introduction to Geocomputation. 100 Units.
This course investigates the theory and practice of computational approaches in Geographic Information Science. Geocomputation is introduced as a multidisciplinary systems paradigm necessary for solving complex spatial problems and facilitating new understandings. Students will learn about the elements of spatial algorithms and data structures, geospatial topologies, spatial data queries, the basics of geodatabase architecture and design, and their implementation in Python.
Instructor(s): Yue Lin Terms Offered: Autumn. Offered 2024–25
Equivalent Course(s): ARCH 28202, GISC 38100, CEGU 28100

GISC 28200. Spatial Analysis Methods in Geographic Information Systems. 100 Units.
This course provides an overview of methods of spatial analysis and their implementation in geographic information systems. These methods deal with the retrieval, storage, manipulation and transformation of spatial data to create new knowledge. Examples are spatial join operations, spatial overlay, buffering, measuring accessibility, network analysis and raster operations. The fundamental principles behind the methods are covered as well as their application to real-life problems using open source software such as QGIS.
Instructor(s): Crystal Bae Terms Offered: Autumn. Offered 2024–25
Equivalent Course(s): GISC 38200, ARCH 28402, CEGU 28200

GISC 28300. Topics in Geographic Information Science. 100 Units.
This advanced course extends and connects both foundational and functional concepts in Geographic Information Science. Students will gain a comprehensive understanding of key areas, including web GIS as well as advanced geospatial visualization techniques. In addition, the course emphasizes the utilization of the R programming language, exposing students to its application within open source software environments through advanced programming and scripting languages.
Instructor(s): Yue Lin Terms Offered: Winter. Offered 2024-25
Equivalent Course(s): ARCH 28602, CEGU 28300, GISC 38300

GISC 28400. GIScience Practicum. 100 Units.
This applied course in geographic information science builds upon and refines knowledge and geocomputational expertise gained in the GIScience sequence. Students will develop a multifaceted GIS project incorporating spatial thinking in design, infrastructure, and implementation. This year's projects will focus on urban renewal in mid-20th century Chicago. Students will conduct guided projects investigating the implications and legacies of urban renewal, utilizing spatial analysis methods such as network analysis, accessibility analysis, machine learning, and/or regression modeling. This course will feature guest lectures from organizations such as the Chicago History Museum and Newberry Library to introduce backgrounds and data on urban renewal in the United States. Students will also share their work in a student-engaged event.
Instructor(s): Yue Lin Terms Offered: Spring. Offered 2024–25
Prerequisite(s): Students must complete GISC 28100/38100, GISC 28200/38200 (or equivalent GISC coursework) and SOCI 20253/30253 Introduction to Spatial Data Science before taking this course.
Equivalent Course(s): CEGU 28400, CHST 28400, GISC 38400

GISC 28700. Readings in Spatial Analysis. 100 Units.
This independent reading option is an opportunity to explore special topics in the exploration, visualization and statistical modeling of geospatial data.
Instructor(s): Staff Terms Offered: Autumn Spring Winter 2023-24
Note(s): This course is consent-only. Students are required to submit the College Reading and Research Course Form. Available for either quality grades or for P/F grading.

GISC 28800. History of Cartography. 100 Units.
This course offers a grand overview of the key developments in mapmaking throughout history worldwide, from pre-literate cartography to the modern interactive digital environment. It looks at the producers, their audience, the technologies and artistic systems used, and the human and global contexts in which they developed. The course also features experiential learning components with field trips to map collections at Regenstein Library and Newberry Library.
Instructor(s): Yue Lin Terms Offered: Autumn 2024–25
Equivalent Course(s): ARCH 28800, HIST 35121, CEGU 28800, HIST 25121, GISC 38800, CHST 28800

GISC 29000. Reading/Research: Geographic Information Sciences. 100 Units.
Independent study for undergraduate students interested in Geographic Information Sciences (GIS). Students and instructors can arrange a Reading/Research course when the material being studied goes beyond the scope of a particular course, when students are working on material not covered in an existing course, or when students

would like to receive academic credit for independent research. Subject, course of study, and requirements must be arranged with the instructor.