# GIS-582: PROGRAMMING FOR GIS-PYTHON APPLICATIONS (FORMERLY GEOG-582)

**Effective Term**
Fall 2025

**BOT Approval Date**
03/20/2025

**Discipline**
GIS - Geospatial Information Science
**Course Number**
582

**Course Title**
Programming for GIS-Python Applications (formerly GEOG-582)

**Short Title**
Programming for GIS

**Credit Status (CB 04)**
D - Credit - Degree applicable

## Units

**Lecture Units**
3.00

**Total Units**
3.00

## Hours

**Lecture Contact Hours**
48-54
**Out of Class Hours Lecture**
96-108

**Total Contact Hours**
48 - 54

**Total Out of Class Hours**
96 - 108

**Total Student Learning Hours**
144 - 162

**Distance Education**
Yes

## Distance Education

**Distance Education Type**
Both Fully Online and Hybrid Online

**Fully Online Delivery Requirements:**
**a. Students must be notified via the college schedule of classes and the syllabus for the class if proctored tests are required for this course**

**b. Any planned face-to-face meetings, such as an orientation or study session, must be optional**
**c. The MSJC curriculum committee requires the use of accessible, asynchronous discussion as a component of every fully online course**

**Are you using publisher content?**

No

**Regular Substantive Interaction**

Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

**Catalog Description**

This course prepares students with the concepts necessary for technical application for programming within the framework of GIS. Topics include variable management, branching and looping, reading and writing from GIS tabular and spatial data, custom tool creation, and tool manipulation. Through practical applications, students will use programming methods to customize and streamline GIS data management and analysis. (formerly GEOG-582)

## Codes

**TOP Code (CB 03)**

2206.10* - *Geographic Information Systems

**CIP Code**

45.0702 - Geographic Information Science and Cartography.

**Repeatability Code**

No

**Grading Option**

Letter grade OR P/NP

**Minimum Qualifications**

| Minimum Qualifications | And/Or |
|---|---|
| Biological Sciences (Masters Required) | Or |
| Ecology | Or |
| Environmental Technologies | Or |
| Geography (Masters Required) | Or |
| Computer Science (Masters Required) | Or |
| Computer Information Systems | Or |
| Earth Science (Masters Required) | End |

## Learning Objectives

**Learning Objectives**

| Learning Objective |
|---|
| 1. Compare and contrast types (strings, numbers, tuples, and others) to identify the appropriateness of each for modeling reality |
| 2. Define and implement variables and functions. |
| 3. Create and effectively use branches, various loop types, and conditions. |
| 4. Investigate and solve scripting errors. |
| 5. Relate programming concepts to GIS data management and analysis. |
| 6. Recognize GIS tasks that are amenable to automation. |
| 7. Manipulate existing GIS tools to customize output. |
| 8. Develop original tools for use in GIS. |
| 9. Formulate script documentation and effective tool help dialogs, anticipating end-user needs recognizing the diversity and equity issue of a variety of human populations. |

## Learning Outcome Information

**Course Learning Outcomes**

| Learning Outcome |
|---|
| 1. The student will evaluate Python programming language as used in GIS applications |
| 2. The student will synthesize geoprocessing and Boolean logic operations of Python as they related to geospatial data analysis. |
| 3. The student will construct a geospatial analysis model workflow script in Python. |
| 4. The student will develop original Python tools for use in GIS applications. |
| 5. The student will evaluate advanced Python program language and scripting processes for GIS. |

## Content

**Course Lecture Content**

1. Introduction to Programming in GIS
   A. Popular Programming Languages
   B. Integration of Programming and GIS
   C. Advanced Algorithms
   D. Geoprocessing and Boolean Logic
   E. Exploring and Manipulating Spatial Data
   F. Programming Considerations of Population Diversity Issues
   G. Programming to Represent Equity Considerations of Human Populations
      1). Socio-economic influences
      2). Ethnic and Racial Considerations
      3). Gender aspects
      4). LGBTQ issues
2. Types and Variables:
   A. Strings
   B. Numbers
   C. Converting Values
   D. Defining Variables
3. Branching and Loops
   A. If/else Branching
   B. While Loops
   C. Conditions
4. Strings and Tuples

A. For Loops
B. Functions with Strings
C. Slicing Strings
D. Understanding Tuples
E. Slicing Tuples

5. Lists and Dictionaries
A. Using Lists
B. Using Dictionaries
6. Functions
A. Creating Functions
B. Parameters and Return Values
C. Global Variables and Constants
D. Importing Function Packages

6. File Management
A. Reading from Files
B. Writing to Files
C. Handling Exceptions

7. Customizing GIS Tools
A. Customizing Script Tools
B. Working with Modeled Workflows
C. Manipulating Modeled Workflows

8. Creating GIS Tools
A. GIS Graphical User Interface
B. Tool Dialog Help and Documentation
C. Setting Tool Parameters
D. Sharing Tools
E. Customizing Tools

9. Spatial Queries
A. Relational Databases
B. Query Languages (SQL)

10. Advanced Program Language and Scripting
A. Working with Geometries
B. Creating Functions and Classes
C. Working with Rasters
D. Map Scripting
E. Debugging and Error Handling

## Methods of Instruction

**Method**

Discussion

**Integration**

Discussion focuses on programming methods and techniques, how to apply techniques to GIS, and the appropriateness for doing so in given contexts especially as the relate to programming considerations of population diversity issues.

**DE Adaptations for MOI**

Instructor-moderated student participation in discussion forums in the course management system. Students receive timely feedback from the instructor via communication tools in the CMS. All materials meet appropriate accessibility standards.

**Method**

Homework

**Integration**

Homework computer lab activities consist of practical applications of real-world scenarios including customizing existing GIS tools (for instance, for exploring types, variables, branching and looping, and conditions). Homework, including computer activities and programing, are used to reinforce lecture content.

**DE Adaptations for MOI**

All homework completed on practical applications and programming is detailed in and submitted to the appropriate applications within the CMS. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. All materials meet appropriate accessibility standards.

**Method**

Lecture

**Integration**

Lecture presents GIS terms, concepts, and methods for programming, such as types, variables, functions, branching and looping, and conditions.

**DE Adaptations for MOI**

Lectures consist of online presentations and demonstrations that are asynchronous in the course management system or interactive real-time webinars that focus on GIS programming terms, concepts and methods, such as types, variables, functions, branching and looping, and conditions. Students receive timely feedback from the instructor via communication tools in the CMS. All materials meet appropriate accessibility standards.

**Method**

Projects

**Integration**

Students work on several phases of programming projects that involve developing original GIS tools that address a specific GIS need, manipulating existing GIS tools to customize output, developing original programming tools, and formulating script documentation and effective tool help dialogs. Students receive input from instructor as they work on various phases of projects.

**DE Adaptations for MOI**

Project details are presented in the appropriate applications within the CMS. All phases of the projects are described including assessment rubrics within the CMS. Students receive input from instructor via the CMS as they work on various phases of projects. Students receive timely feedback from the instructor via communication tools in the CMS. All materials meet appropriate accessibility standards.

**Method**

Film/video Viewing and Discussion

**Integration**

Video demonstrations and webinars are used that focus on GIS programming. These are used to supplement lectures and reinforce student comprehension of lecture content.

**DE Adaptations for MOI**

Videos and websites are described and presented in the CMS. All presentations meet accessibility standards and are available in the course learning management system. Students receive timely feedback from the instructor via communication tools in the CMS.

## Methods of Evaluation

**Method**

Class Participation

**Integration**

Participation in class discussion on Python programming issues is graded based on relevance and added value. Participations includes how programming can represent equity considerations of the diversity of human populations.

**DE Adaptations for MOE**

Students participation rubrics are defined in the course management system. Students participate in asynchronous discussion and work group sessions using various tools in the CMS. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. All materials meet appropriate accessibility standards.

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**Method**

Exams/Tests

**Integration**

Exams/tests use a variety of question formats to assess knowledge of GIS programming terms and concepts, methods and applications. Grading rubrics are designed for individual tests.

**DE Adaptations for MOE**

Tests use a variety of question formats administered and evaluated asynchronously using appropriate tools in the course management system. Grading rubrics designed for individual tests are presented in the CMS. Students receive timely feedback from the instructor via communication tools in the CMS. All materials meet appropriate accessibility standards.

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**Method**

Homework

**Integration**

Homework includes programming practical applications that are designed to improve student performance and comprehension of various topics, from simple to difficult programming tasks, and encourage critical thinking. Certificates of completion of homework programming are graded as pass/no pass.

**DE Adaptations for MOE**

Homework is detailed and submitted for evaluation within the CMS. Homework programming assignments are graded as pass/no pass using a rubric specifically designed for programming applications. Certificates of programming completion are graded as pass/no pass. Students receive timely feedback from the instructor via communication and grading tools in the CMS. All materials meet appropriate accessibility standards.

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**Method**

Projects

**Integration**

Student programming projects are designed to assessed the students ability to independently apply programming methods and technical skills acquired in this course to develop, modify, manipulate and create tools for GIS. Student projects may require students to work independently or in work groups with other students.

**DE Adaptations for MOE**

Programming projects are presented and detailed in the CMS. Students submit individual and group projects in the CMS. Grading rubrics are provided to through the course management system. Projects are evaluated using rubrics designed for each project. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. All materials meet appropriate accessibility standards.

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## Assignments

**Assignment Type**

Writing

**In-class and/or outside of class**

In-class

**Formative or Summative**

Summative

**Assignment**

Using the instructor provided modeled workflow in a GIS interface, review the script underlying the workflow model. Modify some of the parameters in the modeled script to customize the process. Provide a written explanation of your modifications and submit your revised model as a digital file along with a flow chart documenting the changes you made.

**How assignment will be adapted in online format**

Assignment are detailed and submitted within the CMS where they are reviewed by the instructor. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. All writing assignments meet accessibility requirements.

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**Assignment Type**

Writing

**In-class and/or outside of class**

Outside of class

**Formative or Summative**

Formative

**Assignment**

Produce a written critique of Python programming applications related to working with GIS raster data. Consider how programming reflects socio-economic influences, ethnic and racial Considerations, gender and age aspects, and other diversity aspects such as LGBTQ issues.

**How assignment will be adapted in online format**

Rubric for the development of written critiques are presented within the CMS. All materials pertaining to the writing assignment meet accessibility standards. Critiques are submitted within the CMS. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS.

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**Assignment Type**

Reading

**In-class and/or outside of class**

Outside of class

**Formative or Summative**

Summative

**Assignment**

Research internet web sites for white papers, blog and/or other relevant discussions related to the use of Python programming as it applies to Geographic Information Systems concepts and techniques. Submit bibliographic references to a minimum of 3 research articles.

**How assignment will be adapted in online format**

On-line resources to search for relevant discussions are presented in the CMS. Sample resources, bibliographic references and evaluations are available within the CMS. Students submit bibliographic references to a minimum of 3 research articles in the appropriate submission tool within the CMS. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS.

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**Assignment Type**
Reading

**In-class and/or outside of class**
In-class
Outside of class

**Formative or Summative**
Formative

**Assignment**
Review sources of information discovered, during class time or in independent out of class research, to evaluate how useful they are and in the independent design and execution of models representing higher level Python programing GIS skills and applications.

**How assignment will be adapted in online format**
A variety of source information is presented within the CMS. Links to pertinent on-line information sites are made available within the CMS. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. All reference information is presented in accessible formats.

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**Assignment Type**
Writing

**In-class and/or outside of class**
In-class
Outside of class

**Formative or Summative**
Summative

**Assignment**
Research a specific GIS issue or event including population data collection and analysis, as it relates to diverse groups of human populations of specifically recognizing historically marginalized groups of people. Develop a Python programming routine that focuses on GIS applications and methods, problem-solving and decision support systems, for preparation and response to issues of marginalized groups of people. Summarize various readings, include bibliographic information and pertinent applicable GIS information. Present the programming routine to the class and lead a discussion as to how this kind of programming might be used in a variety of GIS applications.

**How assignment will be adapted in online format**
Assignments are presented, detailed, explained, and submitted in the course management system. Programming routines are presented asynchronously to the class in a variety of format, including accessible video. Students lead asynchronous discussions as to how the collection and interpretation of the data might be perceived by members of different populations. All assignment must meet accessibility requirements. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS.

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**Assignment Type**
Reading

**In-class and/or outside of class**
Outside of class

**Formative or Summative**
Summative

**Assignment**
Read and summarize the article, "Harness the Power of GIS with the ArcGIS API for Python". This article is available digitally at https://www.esri.com/about/newsroom/arcuser/harness-the-power-of-gis-with-the-arcgis-api-for-python/#:~:text=The%20ArcGIS%20API%20for%20Python%20allows%20you%20to%20perform%20sophisticated,Esri%20and%20other%20authoritative%20sources.

**How assignment will be adapted in online format**

The source for this article will be available within the CMS. Pertinent on-line information sites about the ArcGIS API for Python are available within the CMS. A student/instructor discussion is made available in the CMS for students to share questions and concerns about the article. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS. The article and all reference information is presented in accessible formats.

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**Assignment Type**

Writing

**In-class and/or outside of class**

Outside of class

**Formative or Summative**

Summative

**Assignment**

Read and summarize the main discussion points of the article: "Autonomous GIS: the next-generation AI-powered GIS", May 2023, Authors: Zhenlong Li and Huan Ning. https://www.researchgate.net/publication/370635187_Autonomous_GIS_the_next-generation_AI-powered_GIS. The summarization shall also include a discussion as to how the A.I. generated interpretation of the data might be perceived by members representing the diversity of human populations and sub-grouping including but not limited to gender, race, ethnic origin, or sexual identity.

**How assignment will be adapted in online format**

The writing assignment is presented, detailed, explained, and submitted in the course management system. Students lead asynchronous discussions as to how the A.I generated interpretation of the data might be perceived by members of representing the diversity of human populations and sub-grouping including but not limited to gender, race, ethnic origin, or sexual identity.. All assignment must meet accessibility requirements. Students receive assessment and other timely feedback from the instructor via rubric and grading tools in the CMS.

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## Course Materials

**Textbooks**

Zandbergen, Paul A. (2020). Python Scripting for ArcGIS Pro Esri Press. ISBN: 9781589484993
Zandbergen, Paul A. (2020). Advanced Python Scripting for ArcGIS Pro Esri Press. ISBN: 9781589486188

Lawhead, Joel (2019). Learning Geospatial Analysis with Python: Understand GIS fundamentals and perform remote sensing data analysis using Python 3.7, 3rd Edition

Yang, Chaowei (2017). Introduction to GIS Programming and Fundamentals with Python and ArcGIS CRC Press. ISBN: 978-1466510081

**Open Educational Resources**

Rossum, Guido Van. (2018) Python Tutorial 3.7.0 .pdf format.
https://bugs.python.org/file47781/Tutorial_EDIT.pdf

Amos, Bader, Jablonski, Heisler. (2020) Python Basics
https://static.realpython.com/python-basics-sample-chapters.pdf

Rossum, Guido Van. (2020) Pythion Tutorial.
https://www.computer-pdf.com/programming/802-tutorial-python-tutorial.html

## Class Size Information

**Class Size**

40

**Class Size Category**

A - Lecture/discussion 40

## Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

**Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.**

Emphasis is placed on the articulation of how contributions to the discipline of Geospatial Science offers students opportunities to foster empathy, expose variant interpretations, and exhibit diverse societal concerns represented the geographic distribution of humans especially as encountered in business and government situations. Diversity issues are interspersed throughout the course content and are emphasized in instruction and assignments as well as the methods of evaluation.

**Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.**

Students are encouraged to investigate not only geophysical aspects of geospatial distribution but as well the socio-cultural perspective, as it pertains to race, gender identity, sexual orientation, and cultural differences particularly as they are expressed and encountered in careers in business and government. Students evaluate the instructional materials and course content from the perspective of their own personal experiences and learning styles. Discussions are designed to allow students to contextualize the course content in relationship to their own learning and to experience the materials from the point of view of other members of the learning community.

## Interactions

**Explain how the course will incorporate student-to-student interaction.**

Students are encouraged to work together to solve geospatial related programming problems that occur related to specific model building situations in GIS applications. In organized work groups students evaluate and navigate the complexity of factors involved in the development of advanced Python program language and scripting. After researching specific GIS issues or events students discuss and evaluate these issues as they relate to diverse groups of human populations of specifically recognizing historically marginalized groups of people. Students work in groups to develop a Python programming routines that focuses on GIS applications and methods, problem-solving and decision support systems. Work groups summarize various readings, and pertinent applicable GIS information. Work groups present the programming routines to the class and lead discussions as to how this kind of programming might be used in a variety of GIS applications.

**Explain how the course will incorporate instructor-to-student interaction.**

The instructor develops and encourages instructor to student interactions during regularly scheduled class time and office hours. Lecture instruction is designed to include instructor to student announcements and individual as well as group evaluation and feedback. The instructor works with individual students as well as small groups to give intensive instructor student one-on-one instruction in the use of the Python language for evaluating geospatial information. To better support a diverse range of learners, instructor incorporates formative and summative active learning strategies emphasizing a diversity of learning styles.

**Explain how the course will incorporate student-to-content interaction.**

Student to content interaction is incorporated in the lecture and software application presentations and assignments as well as weekly formative project and a Capstone semester project. Students review and summarize various programming article to contextualize this information into their own learning. Students contextualize lecture information such as programming to represent equity considerations of various human populations. These interaction take place in the classroom environment as well as within the CMS or video conferencing interactions for courses presented in the on-line line environment.

**Explain how the course will incorporate student-to-self interaction (metacognitive).**

The goal is to support students in connecting their experiences with the terms and concepts presented in the course and to validate the student's life experience by seeing themselves in the material and assignment requirements particularly as it relates to careers in GIS applications in business and government. Student reading, writing, programming and group project assignments are designed to help contextualize this information into their own learning experiences and life interactions.

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