NRM 638 GIS Programming

Fall 2025, Credits: 3, CRN: 75654 (in person/Zoom)

Prerequisite: NRM 338 or Instructor's Permission

Location: O'Neil 307 (in person) and Synchronously Online (Zoom)
Meeting Time: TR 11:30 – 1:00 pm

Instructor: Dr. Santosh Panda (email: skpanda@alaska.edu; phone: 907 474 7539)
Office: Room: O'Neill 368
Office Hours: TR 1:00 – 1:45 pm (face-to-face, phone, Zoom)

Course Description: GIS Python programming for ArcGIS Pro and Google Earth Engine (GEE). Programming for customizing geospatial analysis, efficient batch processing, and development of custom tools for data visualization and analysis. This course is primarily focused on automation of geospatial analysis workflow in **Python** for a variety of geoenvironmental applications.

Course Goals:

1. To learn Python scripting for GIS applications in ArcGIS Pro and GEE.
2. To learn to build scripting tools for data processing automation in ArcGIS Pro.
3. To learn data visualization using Python in ArcGIS Pro and GEE.

Week: Dates	Topics

Week 1: 8/26, 28	Introduction
	- Course introduction (syllabus; course on Canvas)
	- ArcGIS Pro account and software access
	- Introduction to GIS scripting in Python
	  - Python introduction
	  - Best practice: ArcGIS Project set up
	  - ArcGIS Python environments
	  - Python window
	  - Python Notebook
	  - IDLE
	Demo: Running Python code in ArcGIS Pro (Python window, Notebook, IDLE)

Week 2: 9/2, 4	Python scripting for GIS - Python commands (OS module) Tutorial: Get started with Python in ArcGIS Pro Challenge 1 Assigned (due in a week)
Week 3: 9/9, 11	Python data types (string, numeric, list, tuple, dictionary) Python script structure Python variables Python statements, functions and modules Demo: Creating functions and modules Tutorial: Create data types

Week 4: 9/16, 18	ArcPy libraries Python classes and objects Tutorial: clip layers and update fields Tutorial: Run geoprocessing tools with Python Challenge 2 Assigned (due in a week)
Week 5: 9/23, 25	Python script errors - syntax errors - exceptions Script debugging tips - pseudocode - comment out code - use print functions Tutorial: solving scripting errors
Week 6: 9/30, 10/2	Field calculations using Python functions User defined functions in Field Calculator Demos Working with Date and Time data in the Field Calculator Challenge 3 Assigned (due in a week)
Week 7: 10/7, 9	Setting up environment variables Retrieving data properties - definition query - retrieving properties of vector data - retrieving properties of raster data Challenge 4 Assigned (due in a week)
Week 8: 10/14, 16	Applications of ArcPy Cursor Creating data (tables, fields, rows, and field values) Creating points, polylines and polygon feature classes and editing attribute tables Challenge 5 Assigned (due in a week)
Week 9: 10/21, 23	Raster data processing in Python using Spatial Analyst tools Querying raster data (Con, SetNull, IsNull) Raster algebra Tools demo: Reclassify, Region Group, Composite Band Demo: processing elevation raster data Challenge 6 Assigned (due in a week)
Week 10: 10/28, 30	Building ArcGIS script tools Python Toolbox Challenge 7 Assigned (due in a week)

Week 11: 11/4, 6	Data visualization using Python - Introduction to data visualization in Python - tabular and vector data visualization - raster and gridded data visualization Challenge 8 Assigned (due in a week)
Week 12: 11/11, 13	Introduction to Google Earth Engine and Geemap Demo: Basic GEE and Geemap functionality Challenge 9 Assigned (due in a week)
Week 13: 11/18, 20	Visualizing and analyzing GEE data using Geemap functions Demo Challenge 10 Assigned (due in a week)
Week 14: 11/25	Image classification in GEE using Python API (only Tue. lecture; Thanksgiving week)
Week 15: 12/2, 4	GEE applications - analyzing surface water dynamics - global land cover mapping - forest cover change analysis
Week 16: 12/9, 11	**Final exam (take home) assigned on Dec. 9th; Due: Thursday Dec. 11th**

Student Learning Outcomes:

After successfully completing this course you will be able to:

- use python environment and tools with ArcGIS Pro and GEE
- write python script for data processing automation
- develop custom tool/script for vector and raster data analysis
- write python script for tabular, vector, and raster data visualization
- use python outside of ArcGIS Pro (using Jupyter Notebook)

Course Materials:

It's a NoLo (No Cost or Low Cost) course. There is no required textbook for this class. I'll provide all lecture, demo, assignment and reading materials.

Technical Requirements: This course uses ArcGIS Pro software which is available for free to all UA students through http://www.alaska.edu/oit/restricted/. ArcGIS Pro is a Windows based GIS software (requires Windows XP or higher Operating System). Also, the course uses Google Earth Engine cloud computing platform which is available for free; you must sign up for an Earth Engine account at https://code.earthengine.google.com/register.

Course Policies:

Participation: You will use ArcGIS Pro and GEE, and follow along as I teach you new concepts each week (through lectures and demo).

Late Work Policy: Late assignments will be accepted with a 5% penalty per day late (if not approved in advance by the instructor).

Ethical Use of Generative AI Policy:

In this class, the use of Generative Artificial Intelligence (such as GPT-4) to assist with your scripting task and assignment is encouraged. However, the use of AI must be done responsibly and ethically. Here are the specific guidelines for using AI in your assignments:

Cite AI Use:

If you use Generative AI to help draft or edit any part of your code, you must cite this in your assignment submission. Treat the AI as you would another kind of source.

Document Your Interaction:

If you use GPT-4 or a similar tool, maintain a copy of the thread used (the input you provided and the output you received). This must be available upon request to validate your work and process.

Evaluation Policies:

Grades are based on the points (and point percentage) that are attributed as follows:

Ten assignments, 20 points each
One final exam, 50 points
Active participation in lectures and labs (bonus 2%)

Grading criteria:
A (A+: > 94%, A-: > 90%)
B (B+: > 80%, B-: > 70%)
C (C+: > 60%, C-: > 50%)
D (D+: > 45%, D-: > 40%)

Explanation of NB/I/W Grades: This course adheres to the UAF guidelines regarding the granting of NB Grades. The NB grade is for use only in situations in which the instructor has No Basis upon which to assign a grade. In general, the NB grade will not be granted.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy:
"The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, he/she has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

Successful, timely completion of this course depends on committing yourself early and maintaining your effort. To this end, this course adheres to the following UAF Learning Procedures:

1. Failure to submit the first three assignments by the deadline for faculty-initiated withdrawals (the ninth Friday after the first day of classes) could result in instructor initiated withdrawal from the course (W).

How to check your grade: To check your grades in https://canvas.alaska.edu, click on the **Grades** link in the sidebar menu.

Expectation of student effort: Students should expect to spend 10-12 hours per week on this class. Students need to complete all assignments by their due dates.

Academic Integrity: As described by UAF, scholastic dishonesty constitutes a violation of the university rules and regulations and is punishable according to the procedures outlined by UAF. Scholastic dishonesty includes, but is not limited to, cheating on an exam, plagiarism, and collusion. Cheating includes providing answers to or taking answers from another student. Plagiarism includes use of another author's words or arguments without attribution. Collusion includes unauthorized collaboration with another person in preparing written work for fulfillment of any course requirement. Scholastic dishonesty is punishable by removal from the course and a grade of "F." For more information go to Student Code of Conduct. (http://uaf.edu/usa/student-resources/conduct)

Support Services: UAF Student Support Services helps students with registration and course schedules, provides information about lessons and student records, assists with the examination process, and answers general questions. Our Academic Advisor can help students communicate with instructors, locate helpful resources, and maximize their learning experience. Contact the UAF Student Support Services staff at 907. 455.6844 or email: trio.sss@alaska.edu or contact staff directly – for directory listing see: https://uaf.edu/sss/sss-staff/index.php

UAF Help Desk

Go to http://www.alaska.edu/oit/ to see about current network outages and news. Reach the Help Desk at:

- Email at helpdesk@alaska.edu
- Fax: 907450-8312
- phone: 450.8300 (in the Fairbanks area) or 1.800.478.8226 (outside of Fairbanks)

Disability Services: The UAF Office of Disability Services operates in conjunction with UAF Student Support Services. Disability Services, a part of UAF's Center for Health and Counseling, provides academic accommodations to enrolled students who are identified as being eligible for these services. If you believe you are eligible, please visit their website (http://www.uaf.edu/disability/) or contact a student affairs staff person. You can also contact Disability Services on the Fairbanks campus by phone, 907.474.5655, or by email (uaf-disabilityservices@alaska.edu).

UAF Honor Code: As a UAF student, you are subject to the student Code of Conduct. The university assumes that the integrity of each student and of the student body as a whole will be upheld. It is your responsibility to help maintain the integrity of the student community. For additional information, contact the Center for Student Rights and Responsibilities or web https://uaf.edu/csrr/. The UAF Honor Code (Student Code of Conduct) defines academic standards expected at the University of Alaska Fairbanks.

Title IX Protection: University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska. If you believe you are experiencing discrimination or any form of harassment including sexual harassment/misconduct/assault, you are encouraged to report that behavior. If you report to a faculty member or any university employee, they must notify the UAF Title IX Coordinator about the basic facts of the incident.

Your choice for reporting include:

1. You may access confidential counseling by contacting the UAF Health and Counseling Center at 474-7043;
2. You may access support and file a Title IX report by contacting the UAF Title IX Coordinator at 474-6600;
3. You may file a criminal complaint by contacting the University Police Department at 474-7721.

University of Alaska is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: alaska.edu/nondiscrimination.

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8th floor).

UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/.

Student Academic Support:

- Speaking Center (907-474-5470, uaf-speakingcenter@alaska.edu, Gruening 507)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Gruening 8th floor)
- UAF Math Services, uafmathstatlab@gmail.com, Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, https://www.ctc.uaf.edu/student-services/student-success-center/)
- For more information and resources, please see the Academic Advising Resource List (https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf)

Student Resources:

- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, Whitaker 208)
- Student Health & Counseling **[6 free counseling sessions]** (907-474-7043, https://www.uaf.edu/chc/appointments.php, Whitaker 203)
- Center for Student Rights and Responsibilities (907-474-7317, uaf-studentrights@alaska.edu, Eielson 110)

- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement: The University of Alaska is an affirmative action/equal opportunity employer and educational institution. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination.

For more information, contact:
UAF Department of Equity and Compliance
1760 Tanana Loop, 355 Duckering Building, Fairbanks, AK 99775
907-474-7300
uaf-deo@alaska.edu

We want you to know that:

1. UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.
2. Incidents can be reported to your university's Equity and Compliance office (listed below) or online reporting portal. University of Alaska takes immediate, effective, and appropriate action to respond to reported acts of discrimination and harassment.
3. There are supportive measures available to individuals that may have experienced discrimination.
4. University of Alaska's Board of Regents' Policy & University Regulations (UA BoR P&R) 01.02.020 Nondiscrimination and 01.04 Sex and Gender-Based Discrimination Under Title IX, go to: http://alaska.edu/bor/policy-regulations/.
5. UA BoR P&R apply at all university owned or operated sites, university sanctioned events, clinical sites and during all academic or research related travel that are university sponsored.

For further information on your rights and resources click here.

SYLLABUS ADDENDUM: The syllabus addendum contains non-academic information all students must be aware of. You can find the most recent version here:

https://www.uaf.edu/uafgov/faculty-senate/curriculum/syllabus-addendum.php