

## NRM 638 GIS Programming

Spring 2023, Credits: 3, CRN: 37136 (in person), 37138 (Zoom)

Prerequisite: NRM 338 or Instructor's Permission

Location: WRRB 004 Computer Lab (in person) and Synchronously Online (Zoom)

Meeting Time: MW 9:15 – 10:45 am

Instructor: Dr. Santosh Panda (email: [skpanda@alaska.edu](mailto:skpanda@alaska.edu); phone: 907 474 7539)

Office: Room: O'Neill 368

Office Hours: MW 10:45 – 11:30 am (face-to-face, phone, Zoom)

**Course Description:** GIS programming for ArcGIS Pro. Programming techniques for customizing GIS analysis, efficient batch processing, and development of custom tools for data visualization and analysis. This course is primarily focused on automation of GIS analysis workflow in **Python** for natural resource applications.

### Course Goals:

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

Week: Dates	Topics
1: 1/18	Introduction <ul style="list-style-type: none"><li>- Course introduction (syllabus; course on Canvas)</li><li>- ArcGIS Pro account and access</li><li>- Introduction to scripting in GIS</li></ul>
2: 1/23, 25	Python scripting for GIS <ul style="list-style-type: none"><li>- Python scripting environment for ArcGIS Pro (Python window, Notebook, IDLE)</li><li>- Python commands (OS module)</li><li>- Tutorial: Get started with Python in ArcGIS Pro</li></ul>
3: 1/30, 2/1	Python operations (text file, functions for numeric and string variables, list and tuple, dictionary, functions and modules, global variable)
4: 2/6, 8	ArcPy modules and libraries <ul style="list-style-type: none"><li>- Tutorial: Getting started with Notebook in ArcGIS Pro</li><li>- Field calculations using Python parser<ul style="list-style-type: none"><li>o text field; shape field; datetime field</li></ul></li></ul>
5: 2/13, 15	Reading GIS data <ul style="list-style-type: none"><li>- Python window and environment set up</li><li>- Tutorial: Run geoprocessing tools with Python</li></ul>
6: 2/20, 22	Reading GIS data <ul style="list-style-type: none"><li>- Describing and Listing Feature Classes, Rasters, Tables</li><li>- Tutorial: List and describe datasets with Python</li><li>- Loops and decision (if/ elif/ else; while)</li></ul> Creating GIS data using a script

	<ul style="list-style-type: none"> <li>- Creating feature classes and tables</li> </ul> Selection and random choices <ul style="list-style-type: none"> <li>- Querying and random selection using a script</li> <li>- distance between features</li> <li>- buffer</li> <li>- spatial filtering</li> </ul>
7: 2/27, 3/1	Raster data processing <ul style="list-style-type: none"> <li>- Describing raster data properties</li> <li>- Conditional operation</li> <li>- Map algebra</li> <li>- Raster geoprocessing</li> </ul>
8: 3/6, 8	Python scripting within ArcGIS <ul style="list-style-type: none"> <li>- Field calculation</li> <li>- Querying</li> </ul> <p><b>Midterm exam (Mar. 8th)</b></p>
9:	Spring Break (Mar. 13 - 17)
10: 3/20, 22	Applications of ArcPy modules
11: 3/27, 29	Applications of ArcPy Cursor
12: 4/3, 5	Building script tools
13: 4/10, 12	ArcPy mapping modules
14: 4/17, 19	ArcPy spatial modules
15: 4/24, 26	Data visualization using Python <ul style="list-style-type: none"> <li>- Introduction to data visualization in Python</li> <li>- tabular and vector data visualization</li> <li>- raster and gridded data visualization</li> </ul>
16: 5/1, 3	<b>Final exam (take home); Due: Wednesday May 3rd</b>

### Student Learning Outcomes:

After successfully completing this course you will be able to:

- use python environment and tools with ArcGIS Pro
- 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).

**Course Policies:**

Participation: You will use ArcGIS Pro 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).

**Evaluation Policies:**

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

- Six assignments, 20 points each
- One blog/ GIS application discussion/ python demo, 20 points
- One midterm exam, 50 points
- One final exam, 100 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%)

***Blog discussion (Time: 10 minutes; Points: 20):***

Each student will pick a blog article on GIS applications using python scripting in their area of interest and lead blog discussion. All students will be required to read all blogs and participate in the discussion. The student leading the discussion will introduce the blog and highlight the key take points with emphasis on GIS scripting and automation. Other students will get an opportunity to share their take on the blog. We will use Hypothesis (a social annotation tool within Canvas) for all reading assignments.

***Blog scoring rubric (Time: 10 minutes; Points: 20)***

Category	Scoring Criteria	Total Points
Content (10 points)	Introduction is attention-grabbing, lays out the blog's purpose well, and establishes a framework for the rest of the discussion.	4
	Material included is relevant to the overall message/purpose.	2
	Appropriate amount of material is prepared, and points made reflect well their relative importance.	4

	There is a conclusion or final remarks summarizing the key takeaways.	2
<b>Presentation (5 points)</b>	Speaker maintains good eye contact with the audience and is appropriately animated (clear and audible voice).	1
	Visual aids or materials used are well prepared, informative, and effective.	2
	Length of presentation is within the assigned time limits.	1
	Presenter answered all questions fairly.	3
<b>Score</b>	<b>Total Points</b>	<b>20</b>

**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. The first assignment is due one week after the first day of instruction. Failure to submit this quiz within the first two weeks of the course could result in withdrawal from the course.
2. 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](mailto: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](mailto: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](mailto: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](http://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](mailto:speak@uaf.edu)) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8<sup>th</sup> floor).

**COVID-19:** Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website: <https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students>. Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

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](mailto:uaf-speakingcenter@alaska.edu), Gruening 507)
- Writing Center (907-474-5314, [uaf-writing-center@alaska.edu](mailto:uaf-writing-center@alaska.edu), Gruening 8th floor)
- UAF Math Services, [uafmathstatlab@gmail.com](mailto: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](https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf))

#### **Student Resources:**

- Disability Services (907-474-5655, [uaf-disability-services@alaska.edu](mailto: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](mailto: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](mailto: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](http://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

Additional syllabi statement for courses including off-campus programs and research activities:

University Sponsored Off-Campus Programs and Research Activities

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](http://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](#).