

Geospatial Programming and Visualization with Python

Geog 4/591 - Spring 2019

Instructor: Dr. Nicholas Kohler (nicholas@uoregon.edu)

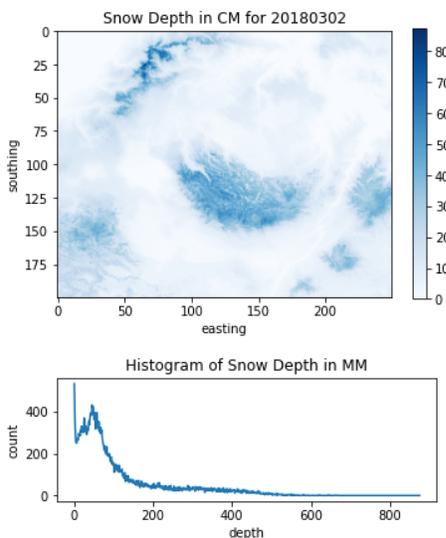
Lecture: Tuesday and Thursday 10:00-10:50 in 360 Condon

Lab: Wednesday or Thursday, 12 to 1:50 in 445 McKenzie

Prerequisites: Geog 481 or Instructor's Consent. *No prior programming experience is required.*

```
In [8]: ### now make a function to open the snowdepth for the date, filter no data values, a
### draws a plot of the snow depth, and a histogram of depth values
def readsnow(dat_date):
    newtif = gdal.Open('us_ssmv11034tS__T0001TTNATS{}05HP001.bil'.format(dat_date))
    print('us_ssmv11034tS__T0001TTNATS{}05HP001.bil'.format(dat_date))

    tifArray = newtif.ReadAsArray()
    newMasked = np.ma.masked_where(tifArray == -9999, tifArray)
```



Course Description

This class introduces students to automated geospatial data collection, analysis, and visualization. Scripting languages and graphic modeling provide a means to efficiently collect and process geographic information, and have become crucial tools for scientists and businesses that use geospatial data.

This course explores the concepts underlying spatial data management, processing, and visualization using the open-source “Python” scripting language. The class will make students comfortable with basic concepts of geospatial data management and the automation of spatial analysis, and will teach them about the application of open-source tools for research and production purposes. Perhaps most important, the class

is designed to foster the ability to continually learn, a necessary skill in the rapidly growing fields which are applying geospatial data science.

Learning Outcomes

The coursework should make students comfortable with geospatial data management, visualization, and processing, and confident in their ability to automate spatial analysis workflows.

In the class students will:

- Identify and manage appropriate data models to represent spatial features
- Analyse and visualize geospatial information
- gain experience writing Python scripts (to download, create, interact with and analyse geospatial data in ArcGIS and other software packages);
- understand the basic concepts behind object-oriented scripting and computing languages; and
- be able to create graphic models and custom tools for spatial analysis projects.

Course lectures cover the basic concepts behind modern scripting languages such as Python and R, introduce students to the paradigms of open-source software and reproducible science, and delve into the concepts underlying spatial data science. In class labs, students will gain hands-on familiarity with using Python to automate geospatial analysis tasks, using tools such as Arcpy, Geopandas, Numpy, and Matplotlib to process and visualize geospatial data.

Readings:

- *Python Scripting for ArcGIS*, 2013. Paul A. Zandbergen
- *Online readings* linked in this syllabus, on [Canvas](#), or in lecture notes and labs.

General Python Geospatial Resources:

- ***Suggested supporting materials:***
 - *A Python Primer for ArcGIS*, Jennings 2011
 - *GIS Tutorial for Python Scripting*, Allen 2014

Introductory programming with Python -

[The Python Tutorial \(2.7\)](#) ; [The Python Tutorial](#) (3) ; [Python for non-programmers](#) ; [How to Think Like a Computer Scientist](#)

GIS Programming and Automation Class - PSU

<https://www.e-education.psu.edu/geog485/node/91> ; “[Other Sources of Help](#)”

Introduction to Python for Computational Science and Engineering

<http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf>

EU Python Course

<https://www.python-course.eu/course.php>

Other relevant books:

ArcPy and ArcGIS: Geospatial Analysis with Python 2015

Programming ArcGIS with Python Cookbook - Second Edition 2015

Student Engagement

How to learn in this class:

It is important that for this course that you ‘learn how to learn’ in the field of geospatial analysis, be able to solve and automate geographic problems, and critically evaluate the use of geospatial data and analysis techniques.

Do class assignments, including reading, on time, this will allow you to engage with your fellow students, the GE, and the lecturer. ‘Active learning’ is encouraged in the course in both lecture and lab session. This requires the students to engage with each other and the course instructors while exploring the course topics through problem solving, group work, and interaction with each other. This helps to encourage the development of geospatial reasoning, the ability to interpret new information, to find and evaluate content, and to solve problems in the application of geospatial processing and spatial analysis.

Course work:

Course work outside of class includes readings and work on the materials assigned in lab. You are expected to do work on labs outside of scheduled lab time - this can be done in the SSIL facilities, the library Reed Room, or on your own computer (talk to the GTF or instructor for more information on getting the software used in lab for yourself)

Estimated undergraduate engagement distribution over the term

Lecture:	20 hours (20 x 1 hour meetings)
Lecture assignments:	20 hours (average)
Readings and materials:	25 hours (@ 15-40 pages per week, average)
Lab Attendance:	20 hours (10 weeks X 2 hours per week)
Lab work - unsupervised:	35 hours (average)

Total	120 hours (40 required attendance, 80 average remaining)

Additional engagement for graduate credit

Group meetings outside class time:	2 hours
Method examples and demonstrations:	14 hours
Annotated bibliography for final project:	4 hours
Final project:	20 hours

Additional Total	40 hours

Grading

Geog 461 requirements:

- 45% Individual and Group Labs and Projects
- 45% Exams and Lecture Assignments (Take Home or In-Class)
- 10% Final Project and Presentation

Geog 561 requirements:

- 40% Individual and Group Labs and Projects
- 45% Exams and Lecture Assignments (Take Home or In-Class)
- 10% Final Project, annotated bibliography, and Presentation
- 5% Methods bibliography and presentation

Course Policies

Grading Rubric

A+ (98% and greater) Only used when a student's performance significantly exceeds all requirements and expectations for the class. Typically very few to no students receive this grade.

A (90% to <98%) Excellent grasp of material and strong performance across the board, or exceptional performance in one aspect of the course offsetting somewhat less strong performance in another. Typically no more than a quarter of the students in a class receive this grade, fewer in lower-division classes.

B (80% to <90%) Good grasp of material and good performance on most components of the course. Typically this is the most common grade.

C (70% to <80%) Satisfactory grasp of material and/or performance on significant aspects of the class.

D (60% to <70%) Subpar grasp of material and/or performance on significant aspects of the class.

F (<60%) Unacceptable grasp of material and/or performance on significant aspects of the class.

Late work

- Lecture and lab assignments: 10% off per day late
- In-class exams and assignments: make arrangements or zero credit if not taken on time.
- Final Project 30% off per day late

Expectations

Attendance is expected at all lectures and all the lab sessions (to which a student is assigned). Since the course is conducted with an emphasis on 'active learning', this requires that students be inclusive of other viewpoints, participate in group exercises inside and outside of class, and be considerate of different levels of knowledge or ways of learning.

Students are expected to follow the UO Student Conduct Code [\[link\]](#), particularly in regard to academic integrity, class attendance and participation, and in regards to plagiarism.

Do not plagiarize your work. Make sure that you give credit where credit is due.

Please visit the UO library guide on 'Citation and Plagiarism' for more details:

<https://researchguides.uoregon.edu/citing-plagiarism/whycite>

Accommodations

The University of Oregon provides individuals with disabilities reasonable accommodations to participate in educational programs, activities, and services. Students with disabilities requiring accommodations to participate in class activities or meet course requirements should first contact the Accessible Education Center (164 Oregon Hall, 346-1155), and then contact the instructor as soon as possible.