Course information and learning outcomes

- ERS 420, Computer Scripting for Data Analysis, 3 credit hours
- Computer Scripting for Data Analysis provides an introduction to computer programming using python, a scripting language with numerical facilities. This scripting language will be applied to data analysis and simple computer modeling emphasizing the analysis of earth and environmental data and simulation of related processes. The course will frequently digress into discussion of mathematical concepts ranging from trigonometry to calculus, to review the mathematics underlying computational methods
- Skills that will be developed through this course focus on improved quantitative abilities and the introduction to computer programing as a tool to solve earth science problems. Students will also learn how to process and display data, improving data analysis and graphing abilities. Finally, students will convert ideas into mathematical expression, improving conceptualization skills.
- Prerequisites: Mat 126 and Mat 127

faculty information

- Andrew Reeve
- Phone:581-2353
- E-mail: asreeve@maine.edu
- Office Hours: MW 9:00-10:00

Readings

Textbooks
- Parkhurst, 2006. Introduction to applied mathematics for environmental science.
- Langtangen, 2009. A primer on scientific programming with python (optional text)
- Haenel, Gouillart, and Varoquaux. 2012, Python Scientific Lecture Notes (available at http://http://scipy-lectures.github.com/index.html)

Articles Computational geology series by H.L. Vacher published in Journal of Geoscience Education. Printouts of these articles are available in a binder in the mailroom. Articles can also be downloaded at http://nagt.org/nagt/jge/columns

Python tutorials . A variaty of on-line resources are are available that aid in learning python.(eg. www.python.org/doc/). Those interested in a easy-to-read overview and introduction to python might read 'A Byte of Pythons' (www.swaroopch.com/notes/python). Dr. Allen B. Downey has several excellent books available in hardcopy or downloadable from Green Tea Press (http://www.greenteapress.com/).

Highly optional Thompson and Gardner (1910) calculus made easy. St. Martin's Press. (inexpensive and excellent simple introduction to calculus, also availble on-line)

Required Software

Homework assignments in this class will require the use of the Python (or Matlab) and a few add-on libraries. All the python tools are freely available and can be downloaded from various internet sites.

- The python language website is www.python.org. Python software for a variety of computer platforms can be found at www.python.org/download/. Note that there are two versions of python (2.7.x and 3.2.x) and there are some minor differences between these versions that will appear in the class.
- Numpy is a library for matrix manipulation that can be downloaded from http://numpy.scipy.org/ (see link at bottom of web page).
- Matplotlib (matplotlib.sourceforge.net/) is a plotting package that will be used to display data.
- Ipython is a console that is useful for working with python (ipython.scipy.org/moin/)

- Finally, a good text editor is needed when preparing programing files. A list of files text editors that support python can be found at wiki.python.org/moin/PythonEditors. I like 'emacs', but also suggest 'scite' and 'geany' as they are easier to install and use. There are also more several tools that integrate an editor with additional tools (integrated development environment) such as spyder and ied, that come with some of the distributions listed below.
- Large monolithic packages are available that include most of this in one package. Enthought (Canopy), Continuum Analystics (Anaconda), pyzo and python(x,y) distribute versions that can be downloaded and installed for non-commercial use.

Course Schedule

Week 1 Introduction to Python; Installing and using the shell to do calculations.

Week 2 Importing modules, python containers, looping and branching.

Week 3 Reading/writing data, functions and creating modules

week 4 classes and object oriented programming.

Week 3 Different types of equations; Plotting with python: CG2,3,8,9

Week 4 Plotting with python: CG29

Week 5 Numpy and Arrays

Week 6 Linear algebra and mass balance modeling: CG12,14,15,P9

Week 7 Root finding and non-linear equations: Pa10

Week 8 Differences in Earth & Enviro. Sciences: Pa2,CG5,16,17 T&G

Week 9 Integration in Earth & Enviro. Sciences: Pa3, T&G

Week 10 Describing problems with ODEs: Pa4,5

Week 11 Integrating Numerically: Pa6

Week 12 Numerically evaluating ODE's: Pa7

Week 13 2nd order ODE's and PDE's: Pa8,11

Week 14 Finite and Finite Volume methods

Week 15 Intro to other python packages.

Grading

Grading will be based on two exams, presentations, and weekly to bi-weekly problem sets.
Grading Option 1 (Undergraduates)

- Midterm Problem, 20% of grade, (week 6 or 7)
- Final Problem, 30%
- Problem Sets, 50% of grade, weekly to biweekly

Grading Option 2 (Graduates)

- Midterm Problem, 20% of grade, (week 6 or 7)
- Final Problem, 30%
- Problem Sets, 40% of grade, weekly to biweekly
- Class Project, 10% of Grade

If you are taking this for graduate credit, you will also be required to do one projects (ideally related to your research interests) either:

- creating a program or script that addresses a research need, or
- learning and describing an 'add-on' library/toolkit

This project will include a written report including 1) an introduction to the problem your addressing or the library your reviewing, 2) methodology behind your program or the library, 3) script(s) (well commented/documented), 4) discussion and conclusion (results and implications of your script, utility of and application).

- If you wish to request an accommodation for a disability, please contact either your instructor or Ann Smith, Coordinator of Student Services for Students with Disabilities (Onward Building, 581-2319) as early as possible in the semester.
- In case of emergency, students will exit from the rear of the building and gather on the lawn behind the building and next to the parking lot.