

SIO 113 - Intro to Computational Earth Science

Computers in Earth Science

Computers are essential to all modern Earth Science research. We use them for compiling and analyzing data, preparing illustrations like maps or data plots, writing of manuscripts and so on. In this class you will learn computer programming with special applications useful to Earth Sciences. The language you will be learning is Python.

Python

. So why Python?

- Flexible, freely available, cross platform
- Easier to learn than many other languages
- It has lots of numerical, statistical and visualization packages
- It is well supported and has lots of online documentation
- The name 'Python' refers to 'Monty Python' - not the snake and many examples in Python documentation use jokes from the old Monty Python skits. If you have never heard of Monty Python, look it up on youtube; you are in for a treat.

Class Structure:

- There will be three lectures a week (except for Memorial Day) plus a discussion session
- Each lecture starts with quick review (~10 min) and proceeds into the topic of the day. Interspersed in the lecture will be time to practice the skills covered in the lecture.
- There will be a programming assignment each week. These are not optional because you can only learn how to program by doing it. This is not a spectator sport.
- On the due date of each assignment there will be "volunteers" from the class who will present their solution. Every one will get a chance to present, so be prepared!
- In lieu of a final exam, there will be a final project - a program of your own design. There is a great deal of flexibility in the choice of what the program will do but there are some compulsory elements to it, which we will discuss in more detail later.

Holiday

There is NO CLASS on May 29th

Class Expectations

- Attendance is mandatory as are all the weekly homework assignments and the final

project. Each of these aspects contribute 30% to the grade.

- Homework will not be accepted late. No excuses! You will lose all points for the assignment if it is not emailed to the TA before class on the due date (one week after it was assigned).
- You may consult your fellow students on your assignments (in fact that is encouraged) but your work must be your own. Copying programs does not help you learn and in fact it is "cheating". Cheating will be reported to the authorities and will result in unpleasantness all around.
- You may also consult any online resources to help you solve your problem. This is also encouraged. But do NOT copy verbatim what you find there. You must re-work anything through your own brain and in your own words or you will not learn how to program.

Class schedule

| | Date | Topic | Application |
|----|------------|---|------------------|
| 1 | 2017-04-03 | Intro to the class | |
| 2 | 2017-04-05 | Variables and Operations | |
| 3 | 2017-04-07 | Data structures | |
| 4 | 2017-04-10 | Dictionaries, program loops (if, while and for) | |
| 5 | 2017-04-12 | functions and modules | |
| 6 | 2017-04-14 | NumPy and matplotlib | seismic record |
| 7 | 2017-04-17 | NumPy arrays | |
| 8 | 2017-04-19 | file systems and paths | |
| 9 | 2017-04-21 | Pandas, file I/O | |
| 10 | 2017-04-24 | lambda, map, filter reduce, list comprehension | |
| 11 | 2017-04-26 | recursions and exceptions | fibonacci spiral |
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| 12 | 2017-04-28 | data wrangling with Pandas | seismic travel time plots |
| 13 | 2017-05-01 | subplots, bar charts pie charts | elemental abundances |
| 14 | 2017-05-03 | histograms and cumulative distribution functions | hypsometric curve |
| 15 | 2017-05-05 | statistics 101 | Univariate data |
| 16 | 2017-05-08 | hypothesis testing t, F | |
| 17 | 2017-05-10 | non-parametric tests | grain sizes? |
| 18 | 2017-05-12 | line and curve fitting | Bivariate data & Hubble plot |
| 19 | 2017-05-15 | object oriented programming | objects and classes |
| 20 | 2017-05-17 | maps | spatial data; earthquake locations/ depths |
| 21 | 2017-05-19 | gridding and contouring | IGRF |
| 22 | 2017-05-22 | 3D plots of points and surfaces | benioff zone |
| 23 | 2017-05-24 | rose diagrams and equal area projections | glacial striations |
| 24 | 2017-05-26 | matrix math - dot and cross products | poles to planes and more |
| 25 | 2017-05-31 | plotting great and small circles | |
| 26 | 2017-06-02 | Time series - periodograms | temporal data; Keeling curve |
| 27 | 2017-06-05 | Animations | Indian plate motion |
| 28 | 2017-06-07 | command line scripts, GUI Pt I | |
| 29 | 2017-06-09 | GUI Pt II | |