

Course Syllabus

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Goals and Description

The course is designed for students with little or no programming experience but with a desire to learn how to develop software to aid in neuroscience research. Given the popularity of Python and the SciPy library among neuroscience labs worldwide, the course will be conducted in Python. However, much of what is learned will be easily translated into other programming languages (e.g., Matlab). In addition to lecture material, each class will include laboratory time during which students will work on specific problems and get direct instruction and assistance.

The course will begin with a basic introduction to programming (variables, functions, using the debugger, etc.) and to NumPy (vectors, matrices, vector-based math). We will quickly transition into writing programs to aid in the analysis of various sources of neuroscience data using these domains to learn programming skills and techniques. Topics will include signal processing, image processing, and data visualization. Once completed, students should be proficient enough in Scientific Python to apply their skills to their own laboratory research.

Objectives

The course uses seven problem sets to assess progress and understanding of programming concepts. Programming is a skill that must be developed through practice and requires not only basic levels of comprehension (knowledge, comprehension, and application), but also deeper levels of understanding (analysis and synthesis) to be able to creatively solve programming challenges. The problem sets are central to developing these skills.

Each problem set consists of Python code written to solve a particular task. Students will be graded based on:

- Whether the stated goals of the problem set were met (does it run and give the correct output?)
- Whether good coding practices were employed (e.g., including appropriate documentation, clarity of code, etc.)
- Whether the program demonstrates a presence or absence of knowledge of the concepts currently being developed (e.g., applying loops, sub-functions, etc. when asked)

Throughout the course, we will share solutions to problems (including the instructor's solutions) to help understand the range of possible solutions and to evaluate what constitutes good or poor solutions.

Logistics

- Course website
 - <https://canvas.eee.uci.edu/courses/19138>











- [Google Drive folder with GDocs versions of materials](#)
(<https://drive.google.com/drive/folders/1yz3AryTVpgPnTNW1oe5NXhaUb7UNE3C4?usp=sharing>)
- Location
 - **BioSci 3 1404** (not McGaugh 1201)
 - Tuesday / Thursday 9:30-10:50
 - No class on 10/17, 10/22, 11/7, & 11/28
- Instructor
 - Craig Stark
 - cestark@uci.edu
- Access to Scientific Python via Anaconda: [Download](#) (<https://www.anaconda.com/download>)
- Dive Into Python 3: <http://diveintopython3.problemsolving.io/>
(<http://diveintopython3.problemsolving.io/>)

















Topic Overview










- Module 1: Basics of programming and Python
 - ints, floats, and bools
 - strings in Python 3
 - lists
 - tuples, sets, dictionaries
 - Preview of NumPy arrays
 - Anatomy of a program (Dive Into Python: Chapter 1)
 - Data types in Python (Dive Into Python: Chapter 2)
 - Understanding scope, variables, and functions
 - Using the IDE
 - Bonus material
 - Directories, Files, and Comprehensions (Dive Into Python: Chapter 3)
 - The filesystem structure
 - Portable code issues
 - Managing and creating paths
 - Globbing
- Part 2: Basics of NumPy and SciPy
 - Differences between NumPy arrays and Python lists
 - Creating arrays
 - empty, ones, zeros, etc
 - The make-it-like functions
 - "Views" or "slices" and the power / danger of the equals sign
 - Indexing arrays
 - Simple indexing
 - Slices
 - Logical indexing
 - Math functions in ndarray objects
 - Built-in function sampler

- Array-based math vs. iteration (why we use NumPy)
- File I/O
- Masked arrays
- Statistical functions in SciPy
- Basic plotting in Matplotlib
- Module 3: Using Pandas for data analysis
 - Data frames and series
 - Selecting portions of data
 - Importing and exporting data into data frames
 - Using Pandas for pretty plots

Course Summary:

Date	Details	
Thu Sep 26, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144405&include_contexts=course_19138)	9:30am to 10:50am
Tue Oct 1, 2019	 Problem Set 1: Ping! (https://canvas.eee.uci.edu/courses/19138/assignments/356290)	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144396&include_contexts=course_19138)	9:30am to 10:50am
Thu Oct 3, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144401&include_contexts=course_19138)	9:30am to 10:50am
Tue Oct 8, 2019	 Problem Set 2: Variables, strings, and lists (https://canvas.eee.uci.edu/courses/19138/assignments/356294)	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144402&include_contexts=course_19138)	9:30am to 10:50am
Thu Oct 10, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144395&include_contexts=course_19138)	9:30am to 10:50am
Tue Oct 15, 2019	 Problem Set Numpy_1: Basics of NumPy (https://canvas.eee.uci.edu/courses/19138/assignments/356295)	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144394&include_contexts=course_19138)	9:30am to 10:50am
Thu Oct 17, 2019	 NO Class (https://canvas.eee.uci.edu/calendar?event_id=144406&include_contexts=course_19138)	9:30am to 10:50am

Date	Details	
Tue Oct 22, 2019	 NO Class (https://canvas.eee.uci.edu/calendar?event_id=144400&include_contexts=course_19138)	9:30am to 10:50am
Thu Oct 24, 2019	 Problem Set Numpy: Finding data https://canvas.eee.uci.edu/courses/19138/assignments/356297	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144399&include_contexts=course_19138)	9:30am to 10:50am
Tue Oct 29, 2019	 Problem Set: Numpy_Guessing https://canvas.eee.uci.edu/courses/19138/assignments/356298	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144403&include_contexts=course_19138)	9:30am to 10:50am
Thu Oct 31, 2019	 Problem Set Numpy: Simple data filtering and plotting https://canvas.eee.uci.edu/courses/19138/assignments/356299	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144404&include_contexts=course_19138)	9:30am to 10:50am
Tue Nov 5, 2019	 (Not so Bonus) Problem Set Numpy_Bonus_1: Using convolution to filter data https://canvas.eee.uci.edu/courses/19138/assignments/356293	due by 9:01am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144398&include_contexts=course_19138)	9:30am to 10:50am
Thu Nov 7, 2019	 NO Class (https://canvas.eee.uci.edu/calendar?event_id=144389&include_contexts=course_19138)	9:30am to 10:50am
Tue Nov 12, 2019	 Problem Set Numpy: Data detrending, averaging, and plotting https://canvas.eee.uci.edu/courses/19138/assignments/356296	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144407&include_contexts=course_19138)	9:30am to 10:50am
Thu Nov 14, 2019	 Problem Set Pandas_1: Data analysis in Pandas https://canvas.eee.uci.edu/courses/19138/assignments/356300	due by 8:59am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144392&include_contexts=course_19138)	9:30am to 10:50am
Tue Nov 19, 2019	 Problem Set Pandas_2: Plotting and grouping https://canvas.eee.uci.edu/courses/19138/assignments/356301	due by 9am
	 Class (https://canvas.eee.uci.edu/calendar?event_id=144387&include_contexts=course_19138)	9:30am to 10:50am

Date	Details	
Thu Nov 21, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144388&include_contexts=course_19138)	9:30am to 10:50am
	 Problem Set Pandas 3: Running statistics (https://canvas.eee.uci.edu/courses/19138/assignments/356302)	due by 9:59am
Tue Nov 26, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144390&include_contexts=course_19138)	9:30am to 10:50am
	 Problem Set Pandas 4: Permutation analysis (https://canvas.eee.uci.edu/courses/19138/assignments/356303)	due by 11:59pm
Thu Nov 28, 2019	 NO Class (https://canvas.eee.uci.edu/calendar?event_id=144393&include_contexts=course_19138)	9:30am to 10:50am
Tue Dec 3, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144391&include_contexts=course_19138)	9:30am to 10:50am
Thu Dec 5, 2019	 Class (https://canvas.eee.uci.edu/calendar?event_id=144397&include_contexts=course_19138)	9:30am to 10:50am
	 Final: Where's the rat? (https://canvas.eee.uci.edu/courses/19138/assignments/356292)	due by 11:59pm
	 (Bonus) Problem Set: Reading directories and showing images (https://canvas.eee.uci.edu/courses/19138/assignments/356291)	