Scientific Computing with MATLAB
Course Outline

Paul Gribble

Psychology 9040A
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Administrivia

- Course number: Psychology 9040A
- Instructor: Paul Gribble
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- office: NSC 228
- lab: NSC 245G
- Course TA: Alex Yan (ayan8@uwo.ca)
- class schedule: Mondays & Wednesdays 1:30pm–2:30pm
- class location: PAB 150
- first class: Wednesday Sep 14, 2016
- course website: http://www.gribblelab.org/scicomp
- course notes: http://www.gribblelab.org/scicomp/scicomp.pdf

Goals of the course

The goal of this one-semester graduate seminar is to provide you with skills in scientific computing—tools and techniques that you can use in your own research. We will focus on learning to think about experiments and data in a computational framework, and we will learn to implement specific data processing and analysis algorithms using a high-level programming language. We will use MATLAB although if you wish to use another language such as Python, R or C you are free to do so.

The course is designed to achieve three primary goals:

1. to teach you to program in a high-level language (MATLAB).
2. to introduce you to some common computational techniques for data processing and analysis—e.g. curve-fitting, simulation, optimization & gradient descent, frequency-domain analysis and filtering, parallel programming, interacting with hardware, organization and storage of data, programming GUIs (graphical user interfaces), etc. This list can be adapted from year to year depending on class demand.
3. to get you to think computationally and algorithmically about data processing, analysis, modeling and visualization.

Even if you don't become a full-fledged programmer yourself, you will have learned enough to know what is possible given today's computational resources. This will enable you in the future to design experiments and data analysis approaches that take full advantage of the computational resources available to you—whether programmed yourself, or by programmers and technicians that you hire.

Topics

We will discuss the list of topics at the beginning of the course, and we will be able to make changes to accommodate the needs of the class.

- basic data types, complex data types
- digital representation of data
- operators & expressions
- control flow (loops, conditionals)
- functions & modularity, variable scope
- input & output
- speeding up your code
- graphical displays of data
- signals & sampling, fourier analysis & filtering
- optimization & gradient descent
- curve fitting
- basic statistical procedures
- resampling & bootstrapping
- basic machine learning

Grades & Assignments

The course is organized in a hands-on fashion. Each week I will talk briefly about the topic at hand, including some live-coding demos, and then we will work together on programming exercises that illustrate the concepts.

Grades will be based on a number of assignments, which will further test your comprehension of the concepts we go over in class. In past years the number of assignments has varied in the range of 5-15.

Prerequisites

There are no prerequisites for this course. You do not need prior experience with programming in order to take this course or to do well in this course. If you do have extensive prior programming experience, you may find this course slightly uninteresting. Having said that, everyone is welcome.

Readings

Course notes are available on the course website here:

http://www.gribblelab.org/scicomp/scicomp.pdf

Occasionally I will point you to other readings as well.