Foundations of Programming for Data Scientists - Syllabus

Fall 2020 - Winter 2021 - Spring 2021

Instructor Information

Instructor	Email	Office Location & Hours
Christian Darabos, Ph.D.	**Christian.Darabos@dartmouth.edu**	**WTRB 315, hours TBD**

General Information

Lectures

- Time: TBD - once a week, 90 minutes
- Format: TBD - face-to-face if possible. Synchronous interactive online otherwise.

Tagline

This course covers the essential concepts of programming to students who desire to **understand computational approaches to problem solving** using live code examples and in-class exercises in Python, R, Bash scripting and High Performance Computing (HPC).

Description

This year-long (3-term) course covers the essential concepts of computer programming to an audience with little to no prior programming experience but a desire to **understand computational approaches to problem solving**. It is fully geared to use live code examples and in-class exercises -- bringing the ideas to life, but without bogging down too much in computer idiosyncrasies. We recommend that you bring a laptop or tablet to lecture each week to follow along with the work.

Expectations and Goals

This course is divided in 3 main aspects: Foundations of Programming, Foundations of Computational Data Science, Foundations of Object Oriented Programming. Our new Data Scientists will get comfortable with a myriad of programming/scripting languages and technologies, and learn to use them to solve the problem at hand. Therefore, this course will be a healthy blend of Python, R, Bash scripting and High Performance Computing (HPC).

Course Materials

Textbook and software

There is an optional free on-line textbook for the course, Project Python. This is the textbook used as CS1 lecture notes. Reading the text and doing the exercises in it is encouraged but not necessary to do well in this course. More material as needed during the term.

For Python, we will be using “notebook environments”, either local (Jupyter Notebooks via Anaconda) or online (Google Colab). For R, we will be using R and R Studio (either installed locally or on HPC). For Bash scripting and to access HPC environments, you will be required to install FastX. Windows PC users will also want to install MobaXterm.

Course Schedule

Fall Term - Foundations of Programming

Topics covered:

- Variables and expressions. Scopes.
- Lists, tuples, dictionaries
- Functions, parameters, return values, libraries, abstraction. Recursion.
- Flow control: loops and conditions. Nesting.
- Debugging (basics), errors and exceptions.
- Defensive programming
- Basic algorithms - search, sort
- Concepts of Object Oriented programming - using objects
- Command line input / BASH scripting

Week	Topic	Reading	Exercises
Week 1			
Week 2			
Week 3			
Week 4			
Week 5 / Midterm			
Week 6			
Week 7			
Week 8			
Week 9			
Week 10 / Finals			

Winter Term - Foundations of Computational

Topics covered:

- Data structures implementation - lists, stacks, queues, dictionaries, trees, graphs
- File input/output
- Data frames
- Plotting (basics)
- Mixing languages BASH + Python

Week	Topic	Reading	Exercises
Week 1			
Week 2			
Week 3			
Week 4			
Week 5 / Midterm			
Week 6			
Week 7			
Week 8			
Week 9			
Week 10 / Finals			

Summer Term - Foundation of Object Oriented Programming

Topics covered:

- Classes
- Methods
- Inheritance
- Encapsulation
- Abstraction
- Class, instance, and static attributes and methods

Week	Topic	Reading	Exercises
Week 1			
Week 2			
Week 3			
Week 4			
Week 5 / Midterm			
Week 6			
Week 7			
Week 8			
Week 9			
Week 10 / Finals			

Coursework, grading

Assignments

Assignments are relatively brief exercises that are usually due week-to-week and will usually consist of one or two short programs to help you understand the concept being covered.

Grading TBD

Exams - Midterms and Finals

One of each in each term.

Grading TBD

How to get help

- Office hours
- Teaching Assistant
- Canvas Discussions
- Slack Channel

Honor Principle

On exams and assignments, all work must be your own. You may work on assignments individually or in groups. Programs that you turn in, however, should be created, typed, documented, and output generated, yourself. To do otherwise is a **violation of the Academic Honor Principle**. If you work with a classmate on any assignment, you should tell us who you worked with in a comment at the beginning of your program.You should attribute the proper source in any code that you submit that you did not write yourself.

Over the years we reuse some exercises, problems, and assignments. You should not look at any solutions to homeworks assigned in previous terms, including sample solutions, or solutions written by other students.

Here is a good rule of thumb. If you are talking in normal English (or some other natural language) you are *probably* OK. If you find yourself talking in Python/R/Bash code, you are not.

When in doubt, ask. If it is too late and you can't find me, erre on the side of caution.

Religious observances

If you have a religious observance that conflicts with your participation in the course, please let me know in the first two weeks of term to discuss appropriate accommodations.

Disabilities

Students with disabilities should discuss with me appropriate accommodations that might be helpful. All discussions will remain confidential, although the Student Accessibility Services office may be consulted to discuss appropriate implementation of any accommodation requested.

Advices

- Participate fully and actively
- Follow along
- Ask a lot of questions
- Start all assignments early
- Work/study between classes - once a week is not enough for most student to both understand **and** assimilate the material
- Collaborate (within the bounds of the Academic Honor Code)
- Ask for help. The purpose of this course is not to waste your time. If you are not making progress on a problem, get help!
- Do not let yourself fall behind - the material builds on itself, and, for some, the pace is fast. As a result, it's easy to fall behind. If you do it's very difficult to recover.

Additional Information and Resources

[Look Great Every Time]
[To replace this placeholder text, just select the line of text and start typing.]

Acknowledgment

Parts of this syllabus are inspired by the online syllabus of Dartmouth's CS1 course.