Florida State UNIVERSITY

Department of Scientific Computing

ISC 2310 - Computational Thinking for Data Science with Python

Online Course Syllabus
Fall 2023

Instructor:
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Tuesday 3-5pm
Zoom links on Canvas

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Course Materials:
Canvas
DeepNote Repository

Course Overview: The goal of data science is to extract useful and nonobvious patterns from a set of data. The goals of this course are to expose students to problems in the major areas of data science (optimization, machine learning, stochastic processes, and data extraction & analysis), to apply concepts in computational thinking to develop algorithms for these problems, and to visualize and interpret the computational results generated by implementing the algorithms. In order to produce and visualize the computational results, students will learn to use the programming language Python which is an open-source (free), high-level, general purpose language available for most operating systems. For ease of learning, students will use Python in a Jupyter notebook environment. To accelerate the student's ability to solve and visualize complex problems in data science, the course makes use of many of the existing libraries available in Python. No prior programming experience is required. After the completion of this course, students should be able to compete for research projects, internships, etc. in data science which have programming components.

Course Prerequisites:. A grade of C- or better in College Algebra MAC1105 or its equivalent.

Learning Outcomes:

By the end of this course, students will demonstrate the ability to:

- explain why data science is a critical emerging field and why computations are needed in this area;
- describe at least two algorithms commonly used in each of the four areas of data science covered in this course;
- compare the computational efficiency of algorithms;
- demonstrate the ability to write and debug simple programs in Python;
- illustrate numerical results of algorithms graphically and to interpret these results;
- analyze large sets of data using Python libraries.

Course Materials: All materials are required unless otherwise labeled.

Canvas: All notes, video clips, assignments, quizzes, exams, due dates, etc. are posted on the course site in Canvas.

Optional Textbook : *Data Science (MIT Press Essential Knowledge series)*, John D. Kelleher & Brendan Tierney, The MIT Press, Cambridge, Mass., 2018

Optional Online Python Resources: See URLs given in Python notebooks and those listed separately in Canvas.

Mandatory First Day Attendance:

FSU has a required first day Attendance Policy. To satisfy this requirement you must introduce yourself to the class by either posting on Canvas Chat or on the discord server. Please provide the following information mentioned below by the end of the first week of classes. Please look at the information other students post because this may be helpful in getting to know other students in the class. Information to post: (i) Name, (ii) Major, (iii) Preferred method of contact by other students (you can put "None" if desired), (iv) Why you are taking this course.

Course Content & Structure: This course consists of six units:

- Unit 1 - Introduction to Computational Thinking, Algorithms and Data Science (1 week)
- Unit 2 - Python Boot Camp (3 weeks)
- Unit 3 - Optimization (1 week)
- Unit 4 - Random Processes (2 weeks)
- Unit 5 - Data fitting (2 weeks)
- Unit 6 - Machine Learning in Data Science (5 weeks)

The last week of the semester is dedicated to a Data Science Project.

For weeks 2 through 4 of the semester we concentrate on learning the basics of Python. By the end of the fourth week you will be able to write a simple program which uses loops and conditionals, contains functions you have written and uses Python libraries. Starting in the fifth week we begin each week by investigating a problem in the field of Data Science along with algorithms to solve it. Then we implement some of these algorithms in Python by using our basic knowledge of Python and various Python libraries. As the semester progresses, we continue to learn new functionality in Python after our initial "Bootcamp."

The course material on Canvas is separated into modules where each module contains what you need to do that week. You should begin each week by looking at the "Road Map" which is the first item in the Canvas module for that week. This will describe the learning objectives for the week and provide an *ordered* list of what you should do that week, including notes to read, videos to watch, assignments, quizzes to take, etc. To learn Python there are videos to watch and accompanying each video there is a completed Jupyter notebook which you can read and use for reference. However, it is helpful to see someone implement the Python commands and write codes "on the fly" so I encourage you to watch the videos. Starting in the fifth week there will be a set of Data Science lecture notes to read first. Each set of written lecture notes have an accompanying video so you have the option to read the notes or watch the video or both. When you have a grasp of the theoretical material proceed to the video clips which describe and implement in Python an algorithm discussed in the notes using a real-world data set. This typically requires learning new Python syntax so you continue to improve your Python skills throughout the semester. However, the programming objective of the course is to have you learn enough Python to investigate some problems in Data Science using real-world data sets, not to make you a Python programmer.

Grading Criteria:

Distribution of points:

Assignment	*Percentage of overall grade*
Quizzes	15%
Data Science Homework	15%
Data Science Exam 1 & 2	25%
Python Practice Notebooks	10%
Python Projects (5)	25%
Final Python Project	10%

As you can see from the point distribution, the theoretical data science material and Python programming are weighted about equally. Quizzes typically cover both Python and Data Science material.

Grading Scale:

A range	90-100	A-	90-92	A	93-100		
B range	80-89	B-	80-82	B	83-87	B+	88-89
C range	70-79	C-	70-72	C	73-77	C+	78-79
D range	60-69	D-	60-62	D	63-67	D+	68-69
F	below 60						

Course Assignments:

Quizzes

Quizzes are important because they ensure that you keep up with the material on a weekly basis. There is one 15 point quiz each week and your final quiz grade is based upon your top 12 quizzes so you are allowed to drop three. All quizzes are taken online and graded immediately; you are free to use your notes, online sources, etc. while taking the quiz but you are only allowed to take each quiz once. If you fail to take a quiz by the due date then it will be one of the quizzes you drop. Consequently *there are no makeups for quizzes*. Accommodations for students with long term, excused absences will be made.

Quizzes are due by Sunday, midnight of the week they are assigned.

Data Science Homework Assignments

Assignments must be done individually and must be submitted by the due date. These are done using "pencil and paper" (i.e., not using Python) and must be submitted in Canvas using either a file upload or text entry. There are 5 assignments and you are allowed to drop 1 assignment throughout the semester so there are *no makeups on homework assignments* and, in addition, *no late homework is accepted.* Accommodations for students with long term, excused absences will be made.

All individual assignments for that week must be completed by midnight on Wednesday of the following week unless otherwise noted in the assignment.

Data Science Exams

The first exam covers the introductory material as well as the topics of optimization, random processes and data fitting. The second exam mainly covers machine learning topics and is assigned in Week 15. The exams are given online and are open notes, etc. However, you should only discuss questions on the exam with the Teaching Assistant or Instructor.

Python Practice Notebooks

Each week there are Python Practice Notebooks assigned. During the "Python Bootcamp" there will be 2-3 each week but later in the course there will typically only be one. These are solely to help you learn to program in Python. To encourage you to complete the notebooks they are counted towards your final grade. However, they are only graded on a scale of 0 to 2 where 2 indicates that you completed all or almost all of the notebook and 1 indicates that you did about half of it; they are not graded for accuracy. The answers are posted after the due date. You can get help on these during Zoom meetings. Remember that the only way to learn a programming language is to practice!

All Python Practice Notebooks are due by Sunday, midnight of the week they are assigned.

Python Projects

There are five regular Python projects throughout the semester covering the areas of basic Python, optimization, random processes, data fitting, and clustering. In addition, there is a final Python capstone project which plays the role of a final exam on Python. All projects must be completed and submitted as a Jupyter notebook through Canvas.

All Projects have their individual due dates but are typically due on Sundays. Usually you will have two weeks to complete these projects. These projects are more involved than the weekly practice notebooks so start early to complete them in a timely fashion!

Python:

Python is probably the most used programming language in the area of Data Science and is an appropriate first language to learn. This course uses a Jupyter notebook environment which is very user-friendly because it has an Input-Output cell format where you enter a command and get the output immediately following it. All Python videos have been made using a Jupyter notebook environment. Instead of having students download Python and the Jupyter notebook environment to their own computer, we have chosen to have you do your programming in the cloud. To facilitate this, we use Deepnote which is very similar to the standard Jupyter notebook but allows real-time collaboration. We have been given a free educational account so there is *no cost to you*. All of the Python assignments for the course will be posted at a Deepnote repository and in a video the first week you will be shown how to get access to the repository. Once you have given me your account information, you will be given access to all the files. When you open an assignment the first thing you should do is make a copy because students have "read only" access to the files. This is all explained in videos posted in the Week 1 Canvas module.

Course Communication:

Announcements

Announcements will be posted in Canvas on a regular basis. They will appear on your Canvas Home Page when you log in and/or will be sent to you directly through your preferred method of notification (you must set this yourself) from Canvas. Please make certain to check them regularly, as they will contain any important information about upcoming assignments or class concerns.

Discord (for common questions)

We use Discord as a forum where you can discuss questions with your classmates or to your instructor or TA. In online courses it is normal to have many questions that relate to the course, such as clarification about assignments, course materials, or assessments. Please post these in our course Discord channel. This is an open forum for the entire class and you are encouraged to give answers and help each other. Remember that everyone in the class sees everything so don't post any private comments/questions that you have. See the next item for private questions.

Email (for private issues)

In this course we will use email for private messages. You can either send it through Canvas or directly to your instructor/TA's email address

Office Hours/Zoom Meetings

The instructor and the TA will hold virtual office hours once a week via Zoom. If you click Zoom on the Canvas Navigation bar (to the left of page) then all recurring Zoom meetings are listed.

Netiquette

When sending emails, posting on chat rooms it is important to understand how to interact with one another online. These rules, called *netiquette*, can be found at `http://www.albion.com/netiquette/index.html`. Please adhere to these guidelines.

University Attendance Policy

Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "... be honest and truthful and ... [to] strive for personal and institutional integrity at Florida State University. (Florida State University Academic Honor Policy, found at http://fda.fsu.edu/Academics/Academic-Honor-Policy).

Americans With Disabilities Act

Students with disabilities needing academic accommodation should:

1. register with and provide documentation to the Student Disability Resource Center; and
2. bring a letter to the instructor indicating the need for accommodation and what type.

Please note that instructors are not allowed to provide classroom accommodation to a student until appropriate verification from the Student Disability Resource Center has been provided.

This syllabus and other class materials are available in alternative format upon request.

For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center, 874 Traditions Way, 108 Student Services Building, Florida State University, Tallahassee, FL 32306-4167, (850) 644-9566 (voice), (850) 644-8504 (TDD), sdrc@admin.fsu.edu, http://www.disabilitycenter.fsu.edu/

Free Tutoring from FSU

On-campus tutoring and writing assistance is available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options - see http://ace.fsu.edu/tutoring or contact tutor@fsu.edu. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

In addition, the campus organization Fellowship of Computational Scientists plans to offer virtual tutoring. When information is available, a course announcement will be made.

Syllabus Change Policy

"Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice."