STA 5934-0002 Statistical Computing with Python
Online

Course Information

Class Meeting Place: **Online or HCB205**
Class Meeting Time: Tuesday/Thursday 4:50-6:05pm
Class URL: On Canvas

Students all meet with instructor for class weekly, synchronously, using Zoom, at a specific class time indicated in the University's course schedule for each semester. Additional asynchronous interactions (e.g., discussion forums) among students and with instructor may also be required to complete the course.

Instructor: Dr. Adrian Barbu

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Office: OSB 305
Office Hours: Tuesday/Wednesday 2:30-3:30pm or by appointment

Teaching Assistant: Teng Wang

E-mail: tw17d@my.fsu.edu
Phone: (850) 567-8173
Office Hours: Tuesday/Thursday 3pm-4pm
Zoom: https://zoom.us/j/3344593772, no password

Textbook: No textbook required. About 50% of the course will follow material from: Problem Solving with Algorithms and Data Structures using Python by Brad Miller and David Ranum, https://runestone.academy/runestone/static/pythonds/index.html

Prerequisites: MAC 2313 (Calculus III), MAS 3105 (Linear Algebra I), STA 2122 (Applied Statistics) or permission from instructor. Familiarity with the Python programming language is encouraged.

Course Objectives: This course provides an introduction to the fundamental elements necessary for conducting research in Machine Learning, Data Science and Computer Vision. **This is not a Python class**, but a class to learn fundamental data structures, algorithms and numerical methods necessary for being a successful researcher. Upon successful completion, a student will be able to:

- compare and contrast many data structures, algorithms and numerical methods with their advantages and disadvantages
- implement the methods or know where to find their implementation
- use existing library software
- determine the most appropriate data structure, algorithm or numerical method for a specific application

Course Topics: This course is an overview of fundamental data structures, algorithms and numerical methods. The following topics will be covered:

- Data structures: stack, queue, list, vector, set, map, hash map
- Algorithms: recursion, greedy method
- Search and sort algorithms, computation complexity in big O notation
- Graph data structures: disjoint-set, graph model, tree properties

- Algorithms for graph optimization: minimum spanning tree, min-cut max flow, Dijkstra's algorithm, all pairs shortest path, A* search
- Loss function optimization algorithms: Gradient descent, Stochastic Gradient Descent, Newton's method, BFGS. Techniques for avoiding local optima using mini-batch, momentum and the Adam optimizer.
- Matrix algorithms: solving systems of equations, condition number, SVD, eigenvalues and eigenvectors, conjugate gradient for large matrices
- Sparse matrices for manipulating large sparse datasets and their algorithms
- Constrained optimization in machine learning and beyond: Lagrange multipliers, KKT conditions, Lagrange duality, Support Vector Machines
- Variational methods for functional optimization: The Euler-Lagrange equation
- Introduction to solving Partial Differential Equations: The Euler method
- PyTorch for automatic differentiation
- Neural Networks and stochastic optimization using PyTorch

Grading: Homework: 90 points, quizzes 10 points. There will be extra 3 points bonus given at the discretion of the instructor for students that have actively participated in the class discussions.
The following scheme will be used to convert the percentage points to letter grades.

[90, 93)	A-	[93, 100]	A		
[80, 83)	B-	[83, 87)	B	[87, 90)	B+
[70, 73)	C-	[73, 77)	C	[77, 80)	C+
[60, 63)	D-	[63, 67)	D	[67, 70)	D+
[0, 60) F					

Course Policy

- **Individual study:** You are expected to read the course material beforehand and ask questions that you have in class.

- **Discussion sessions:** Every class will contain a discussion session where students are expected to participate, present what they understood and ask any questions that they might have about the class material or the homework.

- **Homework:** There will be 12 or 13 homework projects. The homeworks will typically be announced on Thursday and due by the following Wednesday. Late homework will be penalized. The homework must be neatly written, preferably typed and **must be submitted online**. Computer output should be kept to a minimum. The best 9 homeworks will form the homework grade.

- **Quizzes:** There will be biweekly quizzes to check whether the students have studied the material before class. **You must work on the quizzes yourself and not have anybody else do them for you**. The best 10 quizzes will form the quiz grade.

- **Code:** It is acceptable to use code downloaded from the internet for the homework as long as a reference to the code website, package or the appropriate paper is added to the homework report.

- **Attendance:** You are required to attend all classes. The class activities will help you assimilate the lessons more easily, giving you an opportunity for active learning. Do

not let this opportunity slip away. Any foreseen absence must be cleared with the instructor. If the absence is due to emergencies, it is the student's responsibility to notify the instructor at the earliest opportunity of the emergency.

- **Homework re-grade:** If you find errors in grading a homework, you have one week to request a re-grade from the date on which the graded homework is available to the students of the class. Submit an email request detailing the nature of the grading error to the instructor along with the relevant homework.

- **Contacting the instructor or TA outside the class:** You are strongly encouraged to come to the instructor or TA during their office hours. If your schedule conflicts with the office hours, you can make an appointment. You may ask the instructor brief questions by e-mail, but you may be asked to come to office hours or meet in a video-conference session if the instructor thinks that the questions are better answered in person.
  When you send e-mails remember the following:
  - Always e-mail from your FSU accounts. The e-mails from non-FSU accounts may not reach me due to filters.
  - Always write your full name at the end of each e-mail message you send.
  - Always write STA 5934 at the beginning of the subject line.

- **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:**
  Florida State University (FSU) values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive, and welcoming. FSU is committed to providing reasonable accommodations for all persons with disabilities in a manner that is consistent with academic standards of the course while empowering the student to meet integral requirements of the course.
  To receive academic accommodations, a student: (1) must register with and provide documentation to the Office of Accessibility Services (OAS); (2) must provide a letter from OAS to the instructor indicating the need for accommodation and what type; and, (3) should communicate with the instructor, as needed, to discuss recommended accommodations. A request for a meeting may be initiated by the student or the instructor. Please note that instructors are not allowed to provide

classroom accommodations to a student until appropriate verification from the Office of Accessibility Services 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 Office of Accessibility Services, 874 Traditions Way, 108 Student Services Building, Florida State University, Tallahassee, FL 32306-4167; (850) 644-9566 (voice); (850) 644-8504 (TDD), oas@fsu.edu, https://dsst.fsu.edu/oas/

- **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 at 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.

- **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.