AMAT 502—Modern Computing for Mathematicians—Fall 2021 Syllabus

Instructor & TA	Office	Email
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Description of the Course: *Modern Computing for Mathematicians (AMAT 502)* is meant to be the core requirement of the Data Science Masters program here at UAlbany. This course will provide an introduction to programming for students who have never coded before as well as a refresher for more experienced programmers. We will also provide a theoretical and practical introduction into machine learning. At a high-level, this course has three parts:

- 8 lectures on Programming Fundamentals in Python
- 4 lectures on Numpy, SciPy and Statistics
- 12 lectures on the machine learning using Pandas and Scikit-Learn as well as its conceptual underpinnings.

The remaining time is for group projects and presentations. A lecture outline is on Page 3.

Pre-Requisites: Basic undergraduate mathematics such as calculus, linear algebra, probability and stats.

Lecture Place and Times: Due to the Covid-19 pandemic this course will be carried out synchronously online. This means you are expected to come to the Zoom links listed below and participate in lecture. In the past, we've had dedicated virtual machines to host our Jupyter notebooks and to handle assignment distribution and collection. This semester ITS has been slow, so we may have to use an alternative to start the semester.

Class # 7162 is taught synchronously online on *MW 8:00-9:20am* on **Zoom**.

- Zoom Meeting Info
  - https://albany.zoom.us/j/95974136483?pwd=S3o5cmhaZTZyVkJPNUlrZFVaSHphZz09
  - Meeting ID: 959 7413 6483
  - Passcode: 745947
- JupyterHub Server Info
  - *Nota Bene:* You need to be on the UA VPN if you are not on campus.
  - https://amat502-7162-fa21.its.albany.edu/ or GitHub or Google CoLab.
  - your UA id, all lower case
  - your UA pwd

Class # 8039 is taught synchronously online on *MW 1:10-2:30pm* on **Zoom**.

- Zoom Meeting Info
  - https://albany.zoom.us/j/94730932590?pwd=M3NRR0xZaFpZUThPaE8yUFRDdVhyQT09
  - Meeting ID: 947 3093 2590
  - Passcode: 346787
- JupyterHub Server Info
  - *Nota Bene:* You need to be on the UA VPN if you are not on campus.
  - https://amat502-8039-fa21.its.albany.edu/ or GitHub or Google CoLab.
  - your UA id, all lower case
  - your UA pwd

Office Hours: By appointment via Zoom with either me or the TA. Just send us an email. *I will also consider hosting in-person office hours, if enough students want it (on Thursday afternoons).*

Grading Schema:

- 40% Determined by lecture-based exercises and extended programming projects.
- 30% Determined by final project, which will have an individual presentation component and a group writeup component. Groups are 3-5 people.
- 25% Determined by an oral midterm.
- 5% Determined by in-class attendance in Zoom. Absences must be approved by Dr. Curry.

Academic Integrity: Please familiarize yourself with UAlbany's *Standards of Academic Integrity* page: https://www.albany.edu/studentconduct/standards_of_academic_integrity.php

I take violations of academic integrity very seriously. Programming is a subject where it is too easy to cheat yourself of valuable learning opportunities. It is permissible to consult existing questions and answers on *Stack Overflow* or *Geeks for Geeks* or similar programming help websites, but you CANNOT post one of the questions from the HW or projects as a new question to one of these sites or use Chegg or a similar "homework help" service. You are, however, permitted to ask your *coding buddies* (defined below) or me or the TA for help, but you should make sure you've tried to figure it out on your own for 10-15 minutes at least. **The single most important thing to NOT do is to copy large blocks of code from a classmate or the internet. If you are caught copying and pasting someone else's code the following penalty system will apply:**

(1) For the first offense, **a zero for the assignment.**
(2) For the second offense, **an automatic reduction of 10% from your final overall grade I report you to community standards.** This usually works out to lowering your grade by one letter grade and a letter goes on your permanent record.
(3) For the third offense, **you fail the course and may be expelled from UAlbany.**

Coding Buddies: For Fall 2021 I am going to put people into teams of 3-5. These are your coding buddies. *You and your coding buddy (or buddies) are the only people you can collaborate with, without citation, outside of me and Mr. Cardona before the final project.* **If you consult anyone other than one of your coding buddies, you must indicate that under COLLABORATORS on your homework,** assuming our ITS servers are working. I've tried to pair people of similar strengths and put apprentices with one or more greenhorns.

Course Text: We will cover the first eight chapters of Guttag and some of the later chapters as well. We'll also use VanderPlas, which is available freely online.

- Required Text: *Introduction to Computation and Programming Using Python* by Guttag, 3rd ed.
- Additional Free Text: *Python Data Science Handbook* by VanderPlas.
    https://github.com/jakevdp/PythonDataScienceHandbook

Attendance and Missed Work Policy:

Attendance during this course will be mandatory and counts for 5% of your grade. Attendance will be checked by Zoom and require that you turn your camera on during breakout sessions at the very least. Valid excuses for illness and emergencies will be accepted. It is considered the student's responsibility to communicate reasons for missed work and to follow university policy, but I will consider excuses on a case-by-case basis.

See www.albany.edu/undergraduateeducation/attendance.php for more details.

Lecture Outline:

The lectures are pre-recorded and available on YouTube. Search for "AMAT502". The following is the link to the channel.

https://www.youtube.com/channel/UC3HHUGPjUfyH0YmkYXfFMbQ

- Lec 1 = Introduction to Data Science + Basic Numerical Operations,
- Lec 2 = Conditionals and Loops,
- Lec 3 = Bisection Search and Functions, Quick Discussion of Big-O Notation
- Lec 4 = Functions and Recursion,
- Lec 5 = Modules and Data Types, e.g. Dictionaries, Sets, Lists,
- Lec 6 = Slicing Arrays and List Comprehension, λ-functions,
- Lec 7 = Exceptions, Objects and Classes
- Lec 8 = More Object Oriented programming + Intro to Plotting
- Lec 9 = Intro to NumPy
- Lec 10 = Coding Catch-Up: Probability/Stats
- Lec 11 = Coding Catch-Up: TBD
- Lec 12 = Into to Machine Learning: Regression
- Lec 13 = Intro to ML: Classification and Clustering Overview,
- Lec 14 = Pandas
- Lec 15 = K-Means Clustering
- Lec 16 = Principal Component Analysis
- Lec 17 = MNIST via K-means and K-Nearest Neighbors
- Lec 18 = Model Validation and Bias-Variance Tradeoff
- Lec 19 = Naive Bayes Classifier
- Lec 20 = Maximum Likelihood and Logistic Regression
- Lec 21 = SVM: From Hyperplanes to Kernels
- Lec 22 = Decision Trees and Entropy
- Lec 23 = Neural Networks
- Lec 24 = Final Reflection Lecture

Look above for the approximate content of the lectures listed below.

Monday		Wednesday	
Aug 23rd	Lecture 1	**Aug 25th**	Lecture 2
Aug 30th	Lecture 3	**Sep 1st**	Lecture 4
Sep 6th ♡*NO CLASS for Labor Day*♡		**Sep 8th**	Lecture 5
Sep 13th	Lecture 6	**Sep 15th**	Lecture 7
Sep 20th	Lecture 8	**Sep 22nd**	Lecture 9
Sep 27th	Lecture 10	**Sep 29th**	Lecture 11
Oct 4th	Lecture 12	**Oct 6th**	Lecture 13
Oct 11th ♡*NO CLASS for Fall Break*♡		**Oct 13th** ♠**MIDTERM** ♠ **(Covers Lectures 1-12)**	
Oct 18th	Lecture 14	**Oct 20th**	Lecture 15
Oct 25th	Lecture 16	**Oct 27th**	Lecture 17
Nov 1st	Lecture 18	**Nov 3rd**	Lecture 19
Nov 8th	Lecture 20	**Nov 10th**	Lecture 21
Nov 15th ♣**Final Project Proposal Due**♣	Lecture 22	**Nov 17th**	Lecture 23
Nov 22nd	Lecture 24	**Nov 24th** ♡*NO CLASS for Thanksgiving*♡	
Nov 29th ♢**Final Project Group Work**♢		**Dec 1st** ♢**Final Project Group Work**♢	
Dec 6th ♠*Final Presentations*♠		**Dec 8th** ♡*NO MORE CLASSES*♡	