Data-Driven Problem Solving in ME

MECG 542 & MECH 475
Fall 2023
3 Credits

Instructor Info

Masoud Masoumi

Office Hrs: Fridays 10 - 11am

Office: RLC 204

mmasoumi01@manhattan.edu

Course Info

Fridays

2:00 - 4:45pm

Classroom: RLC 107

Overview

This course focuses on the implementation of data analysis to provide optimum solutions to engineering problems. The course will discuss how to: 1) visualize and classify information; 2) identify problems using data analysis and machine learning tools; 3) provide possible solutions and predict outcomes for engineering problems using data mining; and 4) design products and structures informed by data. A broad range of applications within mechanical engineering will be discussed. Three credits.

Learning Objectives

- Understand data-driven problem solving approach
- Learn basic programming as well as data analysis and visualization using Python
- Understand and implement regression, classification, and clustering methods

Material

No textbook is required for this course. All the required materials will be provided. However, the following texts are main references used for this course:

Theory

- The Data Science Design Manual by *Steven S. Skiena* (ISBN: 978-3319554433) [Website: www.data-manual.com]
- Probabilistic Machine Learning: An Introduction by *Kevin Patrick Murphy* (ISBN: 978-0262046824) [Website: https://probml.github.io/pml-book/book1.html]
- Deep Learning by *by Ian Goodfellow, Yoshua Bengio, and Aaron Courville* (ISBN: 978-0262035613) [Website: https://www.deeplearningbook.org]

Programming

- Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter by *Wes McKinney*, 3^{rd} Edition (ISBN: 978-1098104030) [Website: https://wesmckinney.com/book]

Grading Scheme

10%	In-Class Assignments
25%	Homework Assignments
30%	Midterm Project
35%	Final Project

A	Grade $\geq$ 93%
A$^-$	90% $\leq$ Grade $<$ 93%
B$^+$	87% $\leq$ Grade $<$ 90%
B	83% $\leq$ Grade $<$ 87%
B$^-$	80% $\leq$ Grade $<$ 83%
C$^+$	77% $\leq$ Grade $<$ 80%
C	73% $\leq$ Grade $<$ 77%
C$^-$	70% $\leq$ Grade $<$ 73%
D$^+$	65% $\leq$ Grade $<$ 70%
D	60% $\leq$ Grade $<$ 65%
F	Grade $<$ 60%

In-Class Assignments

These assignments are given during the class and you will have time to answer them. Typically, asking you to implement what have been taught in the class right before the assignment. At the end of the class, you will submit your Python Notebook on Moodle with answered in-class assignments for grading.

Homework Assignments

These assignments are provided once a topic has been covered and are usually due the following week, prior to the start of the class. They are presented as Python Notebook files, which you will need to submit on Moodle. Ensure that you have answered all the questions for grading.

FAQs

What if my schedule does not allow me to attend office hours?

You are more than welcome to make an appointment whenever you have a question or concern by contacting me via email.

What are the projects?

The topic for the midterm project will be announced on the 8^{th} week of the semester. It will be an individual project to complete an exploratory data analysis of a given data set. The final project will be a group project and the topic will be decided by the group members. More information regarding the projects' expectations will be provided closer to the end of the semester.

Is there any online resource that you suggest for this course?

Here are a few websites/blogs that I recommend for further reading and interesting articles about data analysis and machine learning:

-https://towardsdatascience.com

-www.kaggle.com/learn

-https://machinelearningmastery.com/start-here

Class Policy & Attendance

Due to the nature of the materials covered in this course, regular attendance is highly recommended. Students are required to fulfill all course requirements as detailed in the course syllabi for their registered courses. Implicit in these requirements is completion of all course assignments and attendance in all classes. Also, if I believe that a student's failure to attend class is substantially affecting his/her course grade, I am obligated to report the situation to the dean of the school in which the student is matriculated. The dean will address the situation with the student. In case you miss a class, it is your responsibility to keep up with the class work and be informed of all announcements in class such as homework assignments, quizzes, etc. Cell phones and all other forms of electronic communication devices, if carried into the classroom, must be turned off. The use of computers and other electronic devices during class is restricted to classroom activities and course applications.

Academic Integrity

The college Community Standards & Student Code of Conduct is central to the ideals of this course. Students are expected to be independently familiar with the code and to recognize that their work in the course is to be their own original work that truthfully represents the time and effort applied. Violations of the Academic Policies of the Community Standards & Student Code of Conduct are most serious and will be handled in a manner that fully represents the extent of the Code and that befits the seriousness of its violation. See the code here. https://inside.manhattan.edu/student-life/dean-of-students/code-conduct.php#academicintegrity for more information.

Diversity and Inclusivity

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender identities, national origins, religious affiliations, sexual orientations, ability, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Accommodations for Students with Special Needs

If you are a student with learning needs that require special accommodation, contact the Accommodation Administrator in Specialized Resource Center (SRC) located in Thomas Hall, Room 3.15 as soon as possible to make an appointment to discuss your special needs. Once your Academic Adjustment/ Auxiliary Form is approved, please meet with me during my office hours and bring the form. You can find more information about SRC and the procedure on their website. https://inside.manhattan.edu/academic-resources/specialized-resource-center/index.php.

Class Schedule

The course will tentatively follow this schedule :

Week	Topic	Date
Week 1	Course Introduction	
	Intro to Python Programming	Sep 1^{st}
Week 2	Intro to Python Programming	Sep 8^{th}
Week 3	Numpy: Working with Arrays and Matrices	Sep 15^{th}
Week 4	Pandas: Working with DataFrames	Sep 22^{nd}
Week 5	Data Visualization - Part I	Sep 29^{th}
Week 6	Data Visualization - Part II	Oct 6^{th}
Week 7	Exploratory Data Analysis	Oct 13^{th}
Week 8	Midterm Project Assignment	
	Model Development & Regression	Oct 20^{th}
Week 9	Regression	Oct 27^{th}
Week 10	Classification: K-Nearest Neighbors	Nov 3^{rd}
Week 11	Classification: Logistic Regression & SVM	Nov 10^{th}
Week 12	Classification: Decision Tree	
	Selected Topics	Nov 17^{th}
Week 13	Thanksgiving Holiday - No Class	Nov 24^{th}
Week 14	Clustering: K-Means	
	Selected Topics	Dec 1^{st}
Week 15	Introduction to Neural Networks	Dec 8^{th}
Week 16	Final Project Presentation	TBA