CIS 4930: Introduction to Multimodal Machine Learning In Python

Class Periods: Tuesday 8:30 AM - 10:25 AM
Thursday 9:35 AM - 10:25 AM
Location: FLG 0230
Academic Term: Spring 2023 (Jan 09, 2023 - Apr 26, 2023)

Instructor: Yingbo Ma
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Credits: 3
***Office* Hours**: Online by appointment. Message by email to request an appointment.

Teaching Assistant(s): TBA

Course Description
Our experience of the world is multimodal. Multiple aspects of the object are captured to transmit information in different media forms like image, text, video, sound, etc. Multimodal machine learning uses machine learning data-driven approaches to jointly learn multiple modalities of data, from natural language and speech to images, videos, and physiological signals. Common applications of multimodal machine learning techniques include multimodal conversational AIs, audio-visual speech recognition, and multimodal smart healthcare systems. This course covers (1) the common modalities (e.g., text, speech, facial expressions, etc.) of data when it comes to real-world applications of machine learning techniques; (2) features that could be extracted from each modality of data and used for machine learning tasks; and (3) multimodal data fusion for joining information from multiple modalities for machine learning tasks. At the end of this course, students will be able to:
- Process common modalities of data regarding real-world applications, including texts, speech, and videos.
- Extract common features from each modality of data for ML training uses.
- Implement ML models for different training objectives with unimodal data.
- Understand ML models for feature fusion from multimodal data.

The goal of this course is to help students understand multimodal data mining workflows, the challenges, and the practical skills of processing and analyzing textual, speech, and video data.

Course Materials: Google Folder
The course materials will be uploaded to UF's google drive. Please log in to google using your ufl.edu email address and the same password you use for all ufl.edu access. Upon doing so, you will be able to access the class google folder that we will use throughout the class.

Course Announcements & Discussion Board: Canvas
We will utilize the Canvas discussion board. You are responsible for keeping up to date on all posts by teaching staff to the Canvas discussion board, as well as announcements distributed via Canvas.

Course Pre-Requisites / Co-Requisites
Programming Fundamentals (such as COP 3503) or equivalent, or permission of the instructor.

Required Textbooks and Software

- Software
  - Python 3.4.3 or later.
  - Code management (e.g., Git).
  - Coding Platform (e.g., Jupiter Notebook, Colab, Pycharm, VSCode).

Optional Materials

- Python Data Science Handbook – Essential Tools for Working with Data, Jake VanderPlas o O'Reilly Media, 2016. The online book is freely available.

Course Schedule[1] (All deadlines are 11:59 pm on the day the item is due.)

Week	Week beginning	Tuesday	Thursday	Deadlines
1	09-Jan	Syllabus Intro	What is Multimodal?	
2	16-Jan	Python Fundamentals (Numpy, Pandas)	Python Fundamentals (MatPlotLib, Scikit-Learn)	
3	23-Jan	ML Fundamentals (Regression & Classification)	ML Fundamentals (Regression & Classification)	
4	30-Jan	ML Fundamentals (Regression / Classification)	ML Fundamentals (SVM, Naive Bayes, and Model Evaluation)	Coding Assignment & Report 1, 03-Feb
5	06-Feb	What is Natural Language Processing?	Language Modality (Words, Syntax, Semantics, Discourse, & Dialogue)	
6	13-Feb	Language Modality (Text Preprocessing)	Language Modality (Features: BOW, TF*IDF, Part-of-Speech, Semantics)	
7	20-Feb	Language Modality (Features: BOW, TF*IDF, Part-of-Speech, Semantics)	Language Modality (Linguistic Feature Extraction)	
8	27-Feb	Guest Talk	Language Modality (Inter-rater reliability, Dialogue Act Classification)	Coding Assignment & Report 2, 03-March

[1] This schedule of topics is subject to change based on the needs and interests of the class. The deadlines are not expected to change.

9	06-Mar	What is Speech Processing?	Audio Modality (Loudness, Pitch, Cepstral, Voice Quality, Fourier Transform, Spectrogram)	
10	13-Mar	Spring Break	Spring Break	
11	20-Mar	Audio Modality (Loudness, Pitch, Voice Quality, Fourier Transform, Spectrogram)	Audio Modality (Acoustic-prosodic Feature Extraction)	
12	27-Mar	Audio Modality (Acoustic-prosodic Feature Extraction)	Audio Modality (Audio Emotion Recognition)	Coding Assignment & Report 3, Mar 31
13	03-April	Final Project Proposal Presentation	Final Project Proposal Presentation	Final Project Proposal Presentation
14	10-April	Video Modality (What is Image Processing?)	Video Modality (Image Processing Basics)	
15	17-April	Video Modality (OpenCV)	Video Modality (OpenFace: Facial Analysis)	
16	24-April	Multimodality (Multimodal ML: 5 Core Challenges, Multimodal Fusion)		Coding Assignment & Report 4, April 28
17	01-May	Final Project (Deadline: 03-May)		Project Writeup

Assignments & Projects
In this course, you need to complete four individual coding assignments and one final project.

For each of the four individual coding assignments, you are expected to:

1. submit the source code through Github. Create a GitHub repository that will be accessible later by our teaching staff. These coding assignments are not designed to challenge you but to ensure you have basic practical coding knowledge of working with different modalities of data (e.g., texts, speech, and video) and how to preprocess the data and build ML models with these data.
2. submit an assignment report (a report template will be provided), including a description of your code, the discussion of results, and your reflection on your thoughts about the assignment. Ensure that your submission is complete and illustrates your understanding of the concepts being assessed.

For the final project, you are expected to:

1. form a group (we encourage you to work in groups of up to four). You are responsible for creating a multimodal dataset and brainstorming project ideas with your teammates. You are expected to use at least two modalities of data streams for your project objective.
2. The goal of the final project is to engage you with hands-on activities with data collection and analysis and get a fundamental understanding of data mining.
3. you will propose your final project ideas on April 4th and 6th.
4. you will submit your source code and turn in a write-up of your project on May 3rd.

Late Assignments

Late assignments will not be accepted. You will receive a grade of zero on an assignment if it is not received on or before the due date. However, at the beginning of the semester, you will be issued one "slip day," which can only be applied to individual coding assignments. When applied, one slip day provides one 24-hour extension on an assignment with no grade penalty. No explanation is required regarding the reason for using the slip day, but you need to notify the teaching staff in advance **before** the initial deadline. Requests for using slip days after the initial deadline will not be accepted.

Evaluation of Grades*:

		Percentage of Final Grade
Individual Coding Assignment	Assignment 1 (Code, Report)	12%, 8%
	Assignment 2 (Code, Report)	12%, 8%
	Assignment 3 (Code, Report)	12%, 8%
	Assignment 4 (Code, Report)	12%, 8%
Final Group Project	Final Project Writeup	12%
	Final Project Proposal Presentation	5%
Extra Credit Opportunities	To be announced	3%
	In Total	100%

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is not required during class, ***except*** *for the dates of Final Project Proposal Presentation (April 4th and 6th)*. Notify the teaching staff in advance if you will be absent on those two days; we will adjust your presentation time accordingly. The instructor will prepare course materials with the expectation that you will attend class and bring a computer to follow along with any practical implementations.

Online Course Recording

Our class sessions may be audio-visually recorded for students in the class to refer back to and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image agree to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who unmute during class and participate orally agree to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature,

which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials are prohibited.

Grading Policy

Percent	Grade	Grade Points
93.0 - 100.0	A	4.00
90.0-92.9	A-	3.67
87.0 - 89.9	B+	3.33
83.0 - 86.9	B	3.00
80.0 – 82.9	B-	2.67
77.0 - 79.9	C+	2.33
73.0 - 76.9	C	2.00
70.0 – 72.9	C-	1.67
67.0 - 69.9	D+	1.33
63.0 - 66.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	F	0.00

More information on UF grading policy may be found at:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
• Your academic advisor or Graduate Program Coordinator
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:
Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.ufl.edu/.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://care.dso.ufl.edu.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.