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

- Office: CSE 445
- Email: yingbo.ma@ufl.edu
- Phone: 352-328-1110

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


Course Schedule¹ (All deadlines are 11:59 pm on the day the item is due.)

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

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.
### 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*:

<table>
<thead>
<tr>
<th>Individual Coding Assignment</th>
<th>Percentage of Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1 (Code, Report)</td>
<td>12%, 8%</td>
</tr>
<tr>
<td>Assignment 2 (Code, Report)</td>
<td>12%, 8%</td>
</tr>
<tr>
<td>Assignment 3 (Code, Report)</td>
<td>12%, 8%</td>
</tr>
<tr>
<td>Assignment 4 (Code, Report)</td>
<td>12%, 8%</td>
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<tr>
<td>Final Group Project</td>
<td></td>
</tr>
<tr>
<td>Final Project Writeup</td>
<td>12%</td>
</tr>
<tr>
<td>Final Project Proposal</td>
<td>5%</td>
</tr>
<tr>
<td>Extra Credit Opportunities</td>
<td></td>
</tr>
<tr>
<td>To be announced</td>
<td>3%</td>
</tr>
<tr>
<td>In Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

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**

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

More information on UF grading policy may be found at:
[http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades](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](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/](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/](https://ufl.bluera.com/ufl/). Summaries of course evaluation
results are available to students at [https://gatorevals.aa.ufl.edu/public-results/](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/](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](https://registrar.ufl.edu/ferpa.html)

**Campus Resources:**

**Health and Wellness**

<table>
<thead>
<tr>
<th>U Matter, We Care:</th>
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<tbody>
<tr>
<td>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 <a href="mailto:umatter@ufl.edu">umatter@ufl.edu</a> 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.</td>
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</tbody>
</table>
Counseling and Wellness Center: [http://www.counseling.ufl.edu/cwc](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](mailto:title-ix@ufl.edu), 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/](http://www.police.ufl.edu/).

**Academic Resources**

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

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

**Library Support**, [http://cms.uflib.ufl.edu/ask](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/](https://teachingcenter.ufl.edu/).

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

**Student Complaints Campus**: [https://care.dso.ufl.edu](https://care.dso.ufl.edu).