

Multimodal Data Mining
BME 6938/CIS6930 Sections: 31B1, 1XYZ
Class Dates: 1/09/23 - 4/26/23
Class Period: W | Period 5-7 (11:45 AM-2:45 PM)
Location: CSE E309
Academic Term: Spring 2023

1. **Instructor:** Professor Ruogu Fang
 - E-mail address: ruogu.fang@ufl.edu
 - Office location: BMS J287
 - Telephone: 352-294-1375
 - Website: Canvas Page
 - Office hours: Wednesday 1:30 PM – 2:30 PM

2. **Description:** (3 credit hours) – Multimodal data mining, machine learning, and data integration course using computer programming languages for multimodal biomedical data analysis, including medical images, clinical natural language processing, genomics, and other clinical data.

3. **Pre-requisites:** Foundational knowledge in MATLAB or python and computer programming is needed to be successful in this course.

4. **Course Objectives:**
 - Understand multimodal data mining in the biomedical domain.
 - Understand the concept, approaches, and limitations in analyzing different modalities of biomedical data.
 - Learn to use biomedical data processing and machine learning techniques to analyze multimodal biomedical data.

5. **Contribution of course to meeting the professional component:** 3 credits of engineering topics (no design component)

6. **Class schedule:** This is also a seminar-style course including expert lectures, student paper presentations, and an NIH-style grant proposal or MICCAI-format paper with a demo as the final project. Each week, you will have one to two ~50-minute recorded video lectures (recommend viewing twice at least) released on Monday at 10 AM. The office hour will be following the in-person meeting on Wednesday from 1:30-2:30 PM in the classroom. On each Wednesday, we will host a guest lecture or a student-led, in-depth doctoral comprehensive exam (DCE)-style scientific paper presentation including a background introduction and tutorial, followed by critiques and discussion.

7. **Material and Supply Fees:** N/A

8. **Textbooks and Software Required**
 - Textbooks required for this course are freely available online at the links below. The acronyms for each textbook will be referred to in Section 10 Course Outline Readings.
 1. [DM] Data Mining: Concepts and Techniques, 3rd ed. Jiawei Han, Micheline Kamber, and Jian Pei. Morgan Kaufmann Publisher, July 2011. [\[Link\]](#)
 2. [DL] Deep Learning, MIT Press, Ian Goodfellow, Yoshua Bengio, Aaron Courville. [\[Link\]](#)

- **Software:** MATLAB (info.apps.ufl.edu or in CSE Active Learning Lab) or Python (recommend Anaconda) (free)

9. Recommended Reading:

- [PML] Python Machine Learning, Sebastian Raschka, Packet Publisher. 3rd ed. [[Code](#)]
- [D2L] Dive into Deep Learning (interactive book with code) [[Link](#)]
- Standard cs231n. <http://cs231n.stanford.edu/>.
- Stanford cs244d. <http://cs224d.stanford.edu/>

10. Course Outline: tentative schedule (subject to change)

Notation: *L*: Lecture, *P*: Presentation, *S*: Hands-on Session, *G*: Guest Lectures, **Bold**: In-Person Session.

Week	Day	Date	Sec	Topic	Reading	Quiz/HW	Project	
Module								
Part 1: Multimodal								
			L0	Introduction & Course Logistics			Release	
1	W	1/11	L1	Welcome! How to Read Papers				
			S1	Python: Introduction		Quiz 1		
			L2	Biomedical Image Analysis				
2	W	1/18	G1	HiperGator Tutorial (Matt Gitzendanner)	HPG account			
			S2	Python: Numpy	Paper Selection	Quiz 2	Group	
			L3	Biomedical Image Filtering				
3	W	1/25	G2	Image Processing and Machine Learning on HPG-AI (Yunchao Yang)		HW1 release		
			S3	Python: Pandas		Quiz 3		
			L4	Edge Detection				
4	W	2/1	G3	GitHub Tutorial and Demo (Hao Ye)		HW1 due		
			L5	Morphological Operations		Quiz 4		
			L6	Neuroimage Analysis (Joseph Gullett)				
5	W	2/8	P1	Paper Presentation & Critique	Dehazing			
			S4	Neuroimage Hands-on Session	Install FSL			
			L7	Natural Language Processing (Yonghui Wu)		HW2 release		
6	W	2/15	G4	NLP Hands-on Session (Borui Zhang)				
			S5	NLTK Toolbox Tutorial		Quiz 6		
			L8	Genomic Medicine (Yan Gong)			Milestone 1: Topic	
7	W	2/22	P2	Paper Presentation & Critique	Metabolomic			
			S6	GWAS Hands-On (Yan Gong)	Install PLink	HW2 due		
Part 2: Data Mining								
			L9	Machine Learning	DM 8.1			
8	W	3/1	P3	Paper Presentation & Critique	CNN Review			
			L10	Evaluation	DM 8.5	Quiz 8		
			L11	Supervised Learning: KNN, Naïve Bayes, SVM	DM 8.3, 9.3, 9.5	HW3	Milestone 2: Specific	
9	W	3/8	P4	Paper Presentation & Critique	Physical Activity	release	Aims	
			L12	Decision Tree, Neural Networks	DM 8.2, 8.6	Quiz 9		
		3/15	Spring Break (no class)					
			L13	Unsupervised Learning: Partition Clustering	DM 10			
10	W	3/22	P5	Paper Presentation & Critique	Failures	HW3 due		
			L14	Unsupervised Learning: Hierarchical Clustering	DM 10	Quiz 10		
			L15	Deep Learning & CNN	DL 9, PML 15		Milestone 3: Research Strategy	
11	W	3/29	P6	Paper Presentation & Critique	Transformer			
			S6	Tensorflow, Keras, and CNN		Quiz 11		
			L16	Recurrent Neural Networks (RNN)	DL 10, PML 16			
12	W	4/5	G5	AI for Nursing EHR (Tamara Marciera & Ragnhildur Bjarnadottir)	Seq2seq (NeurIPS'14)			
			S7	RNN Programming Tutorial		Quiz 12		
			L17	Generative Adversarial Networks (GAN)	DL 11		Milestone 4: Preliminary Results	
13	W	4/12	P7	Paper Presentation & Critique	GAN			
			S8	GAN Programming Tutorial		Quiz 13		
			G6	Causal AI (Jie Xu)	Causal ML			

14	W	4/19		Project teamwork and discussion	
				Project Presentation & Demo	
15	W	4/26	L18	Closing Remarks	Report due 4/30

11. Attendance Policy, Class Expectations, and Make-Up Policy.

Attendance:

- View the recorded lecture videos (recommended twice) on time.
- Attend on-time attendance to in-person sessions.
- Attend office hours if having questions.

Expectations:

- Schedule video lecture “class times” for yourself.
- Complete the course activities (lecture videos, quizzes, homework) on time.
- Every week’s module will be available every **Monday at 10 AM** via Canvas.
- Quizzes and programming assignments are due **Friday at 11.59 PM**.
- Paper presentations and discussions are due every **Tuesday at 11.59 PM**.
- Write your code. Do not copy code from others (Code plagiarism will be checked)
- Practice implementing newly learned concepts will make you learn better
- Think creatively for final projects
- Better late than never
- Ask for help if you need it (the instructor holds office hour every Wednesday)

12. Evaluation of Grades:

Assignments	Percentage of Final Grade
Quiz	10%
Paper Presentation & Discussion	15%
Programming Assignments	30%
Admin + Attendance	5%
Final Project	40%
Total	100%

a. Quiz

Quizzes contribute 10 points to your grade. Quiz questions will be asked at the end of each module to help students consolidate their knowledge.

b. Paper Presentation, Critique & Discussion

Paper presentation, critique & discussion contribute 15 points to your grade, including 10 points for presentation & critique, and 5 points for discussion. Every week, students will present, and critique 1-2 papers related to the topic of the week. Students will work in groups (size depending on the enrollment number). Each week, one group will present and facilitate a discussion at the end, and all other students submit the discussion on Canvas and contribute to the live discussion during the class. Students will sign up for a paper presentation with discussion and Q&A in Week 2 after groups are formed. We have a detailed rubric for students’ presentations and discussions.

Presentation:

Paper presentation and discussion facilitation contribute 10 points to your final grade. You are expected to introduce the background and related methods as a tutorial, present the paper content, and demonstrate applications/visualization using the paper’s method (if you can find the code, that will be best). You will also serve as a discussion leader for a 10-minute discussion of your presented paper and

the expert speaker's content. The format of the discussion will be left up to the group leading it that day. Paper Presentations will be graded on the quality of the presentation of the materials contained in the paper. Quality of presentation is defined as a) tutorial-style introduction of research background and related literature, b) presentation of slides relating the content of the paper to peers, and c) demonstration of evidence of critical thinking regarding the content of the paper. Facilitated Discussion will be graded on the ability of the presenter to initiate and maintain relevant discussion of the presented paper and relevant topics (all discussions are visible to the class on Canvas).

Discussion:

Paper discussions contribute 5 points to your final grade. Students are expected to actively participate in the weekly paper discussion on Canvas and live discussion after presentations in the class. That week's student presenter will facilitate the discussion, but fellow students need to use this opportunity to explore their questions related to the week's content on the paper presented. You can also follow up with the discussion/questions posted by your fellow students on the Discussion Board on Canvas.

Due: All paper presentation slides and discussion on due **Tuesday at 11.59 PM (EST)** via Canvas. Paper Discussion will be graded based on the relevance of submitted questions to the week's paper and the demonstration of critical thinking about the content of the week's paper.

Paper Presentations and Discussion Facilitation Grading Rubric .		
Requirement	Percent of Assignment Grade	Final Grade Points
50-minute presentation of the selected paper.	66.7%	10
10-minute discussion	33.3%	5

c. Programming Assignments

Programming assignments will contribute 30 points to your final grade. It will be Jupiter Notebook or python programming assignments.

d. Admin & Attendance

Administrative assignments (e.g., Introduce yourself discussion, Microsoft Teams), attendance to in-person class sessions, and evaluations at the end of each module will contribute 5 points to your final grade.

e. Final Project

The Final Project will contribute 40 points to your grade. This project report will be

- 1) an R21/R03 style research project proposal (6 pages single-spaced) with a one-page specific aims page (7 pages total). Students must also include a bibliography of citations referenced in the text, but this text does not count toward the 7-page document length. The font must be Arial 11 single-spaced with no more than 1-inch margins on all sides.
- 2) a MICCAI format paper ready for submission. Papers must be submitted electronically in searchable pdf format following the guidelines for authors and LaTeX and MS Word templates available at [Lecture Notes in Computer Science](#). Manuscripts should be up to 8 pages (text, figures, and tables) plus up to 2 pages of references. No modifications to the templates are permitted.

This proposal/manuscript can focus on the student's specific area of graduate research and will be expected to integrate two or more methods as a central feature of the research proposal and demonstrate the integration of core knowledge of multiple modalities and machine learning/deep learning in

biomedical engineering. This is intended to demonstrate the student's mastery of the conceptual and practical application of methods and theoretical content covered during the course in their research program.

Category	Requirements	Percentage	Points	
Report (50%)	Specific Aims: with at least 2 specific aims and 1 specified hypothesis per specific aim / Abstract: 1 paragraph abstract of the MICCAI paper	1 page - ~0.5 pg	10%	4
	Research Strategy: Significance, Innovation, Design, and Methods sections / Manuscript introduction and methodology	6 pages -	15%	6
	Preliminary Results / Results & Analysis	8 pages	15%	6
	Bibliography		5%	2
	Language & Format		5%	2
Code (10%)	The program runs well and produces the expected results	10%	4	
Present (30%)	Final Project Presentation	20%	8	
	Demo: Live demo of applying your system/method	10%	4	
Milestone (10%)	Milestone 1: Topic	2.5%	1	
	Milestone 2: Specific Aims	2.5%	1	
	Milestone 3: Research Strategy	2.5%	1	
	Milestone 4: Preliminary Results	2.5%	1	
Award	(Extra Credit) Best and runner-up in Oral Presentation	+5%/+2.5%	+2/+1	
Score	Total Points	(100+5)%	40+2	

13. Grading Scale:

Points	Grade	Grade Points
93.00 - 100.00	A	4.00
90.00 - 92.99	A-	3.67
87.00 - 89.99	B+	3.33
83.00 - 86.99	B	3.00
80.00 - 82.99	B-	2.67
77.00 - 79.99	C+	2.33
73.00 - 76.99	C	2.00
70.00 - 72.99	C-	1.67
67.00 - 69.99	D+	1.33
63.00 - 66.99	D	1.00
60.00 - 62.99	D-	0.67
0 - 59.99	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Late Policy:

- This applies to quizzes, paper discussion questions, aims page, and project milestone reports.

- Does not apply to paper presentations, modality presentations, project final presentations, final project reports, and final project code.
- The first-time late submission will be given a warning only. From the second time on, (number of late minutes * 0.1 points) will be deducted from the points of the late assignment, e.g., 30 min late = $30 * 0.1 = 3$ points if you did not make any mistakes.

14. Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

15. 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 professionally and respectfully is available at <https://gatorevals.a.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.a.ufl.edu/public-results/>.

16. 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.

Honor Code

- If you turn in someone else’s work as if it were your own, you are guilty of cheating. This includes homework, codes, projects, quizzes, paper critiques, presentation slides (without citation or proper credit giving), and any required course turn-in material.
- You are also guilty if you knowingly aid in cheating.
- Software will be used to compare your submitted work to others.
- However, it is okay to discuss with other classmates about homework, paper critiques, and group projects (obviously, okay to work with a project partner). But everyone must turn in their original work.
- Do not post your work on public repositories like GitHub (private repositories are fine)
- If we catch you cheating, you will get negative points on the assignment: It is better to not do the work than to cheat! If it is a midterm exam, final exam, or final project, you get an E (fail) in the class. All cases of cheating will be reported to the office of student conduct.

17. 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

18. 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.

19. Student Privacy

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

20. 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 support, 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>.