Multimodal Data Mining
BME 6938 Sections: 31B1,31B9, MDM1, MDM2
Class Dates: 1/11/21 - 4/21/21
Class Period: M,W,F | Period 4 (10:40AM-11:30AM)
Location: Online
Academic Term: Spring 2021

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: Friday 3:00 – 4:00 pm virtual office hour via Zoom (same link for lectures, office hour, and hands-on training)

2. **Description:** (3 credit hours) – Multimodal data mining, machine learning, and data integration course using computer programming languages for biomedical data analysis.

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**: Each week, you will have two ~50-min recorded video lectures (recommend viewing twice at least) released on Monday 10AM. Virtual office hour will be on Friday 3:00 – 4:00 PM on Zoom. Each Wednesday we will host a doctoral comprehensive exam (DCE)-style scientific paper presentation by students followed by critiques and discission. This is also a seminar-style course including expert lectures, student paper presentation, and a NIH-style grant proposal as the final project.

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

8. **Textbooks and Software Required**
   - Textbook 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]
   - 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. **Bold**: Synchronous Zoom Sessions.*

Week	Day	Date	Sec	Topic	Reading	Quiz	Project
Module				**Part 1: Multimodal**			
1	M	1/11	L1	Introduction & Course Logistics			Release
	W	1/13	L1	**Welcome!** How to Read Papers			
	F	1/15	S1	Python: Introduction		Quiz 1	Group
2	M	1/18		Holiday: Martin Luther King Day			
	W	1/20	L2	Biomedical Image Analysis	Paper Selection		
	F	1/22	S2	Python: Numpy		Quiz 2	
3	M	1/25	L3	Biomedical Image Filtering			
	W	1/27	P1	**Paper Presentation & Critique**			
	F	1/29	S3	Python: Pandas		Quiz 3	
4	M	2/1	L4	Edge Detection			
	W	2/3	P2	**Paper Presentation & Critique**			
	F	2/5	L5	Morphological Operations		Quiz 4	Aims Page
5	M	2/8	L6	**Neuroimage Analysis (Joseph Gullett)**			
	W	2/10	S4	**Neuroimage Hands-on Session**	Install FSL		
	F	2/12	P3	**Paper Presentation & Critique**		Quiz 5	
6	M	2/15	L7	**NLP for EHR (Yonghui Wu)**			
	W	2/17	P4	**Paper Presentation & Critique**			
	F	2/19	S5	**NLP Hands-on Session**		Quiz 6	
7	M	2/22	L8	**Genomic Medicine (Yan Gong)**			
	W	2/24	P5	**Paper Presentation & Critique**			
	F	2/26	S6	**GWAS Hands-On (Yan Gong)**	Install PLink		Milestone 1
				Part 2: Data Mining			
8	M	3/1	L9	Machine Learning	DM 8.1		
	W	3/3	P6	**Modality Presentation**			
	F	3/5	L10	Evaluation	DM 8.5	Quiz 8	
9	M	3/8	L11	Classification: KNN, Naïve Bayes, SVM	DM 8.3, 9.3, 9.5		
	W	3/10	P7	**Modality Presentation**			
	F	3/12	L12	Decision Tree, Neural Networks	DM 8.2, 8.6	Quiz 9	
10	M	3/15	L13	Metrics	DM 8.5		
	W	3/17	P8	**Modality Presentation**			
	F	3/19	L14	Unsupervised Learning: Clustering	DM 10	Quiz 10	Milestone 2
11	M	3/22	L15	Deep Learning & CNN	DL 9		
	W	3/24		Spring Recharge Day (No Class)			
	F	3/26	S6	Tensorflow, Keras and CNN	DL 9	Quiz 11	
12	M	3/29	L16	Recurrent Neural Networks (RNN)	DL 10		
	W	3/31	P9	**Modality Presentation**			
	F	4/2	S7	RNN Programming Tutorial	DL 10	Quiz 12	
13	M	4/5	L17	Generative Adversarial Networks (GAN)			
	W	4/7	P10	**Modality Presentation**			
	F	4/9	S8	GAN Programming Tutorial	DL 11	Quiz 13	

14	M	4/12	L18	**Causal AI (Jiang Bian)**	
	W	4/14	P11	**Modality Presentation**	
	F	4/16	S9	**GitHub for data science (Hao Ye)**	Quiz 14
15	M	4/19	L19	**Closing Remarks**	
	W	4/21	P12	**Project Oral Presentation**	Report due 4/28

Online Course Recording
Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing 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 un-mute during class and participate orally are agreeing 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 is prohibited.

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

Attendance:

a. View the recorded lecture videos (recommended twice) on time.
b. Attend on time attendance to synchronous sessions.
c. Attend office hours if having questions.

Expectations:

- Schedule "class times" for yourself.
- Complete the course activities (lecture videos, quizzes, homework) on time.
- Every week's module will be available every **Monday at 10AM** via Canvas.
- Quizzes are due every **Friday 3 PM** (before office hour so you can ask questions).
- Paper presentation, critique slides, and discussion questions are due every **Tuesday 11.59 PM.**
- Write your own code. Do not copy code from others (Code plagiarism will be checked)
- Practice implementing when learning concepts will make you learn better
- Think creatively for final projects
- Better late than never
- Ask for help if you need it (instructor holds office hour every Tuesday)

12. **Evaluation of Grades**:

Assignments	Percentage of Final Grade
Quiz	20%
Paper Presentation & Critique	20%
Paper Questions & Discussion	5%
Admin + Attendance	5%
Final Project	50%
Total	100%

a. Quiz

Quiz comprise of 20% of your grade (20 points). Quiz questions will be asked at the end of each module to help students consolidate their knowledge.

b. Paper Presentation & Critique

Paper presentation & discussion will comprise 20% of your grade (20 points). Every week the class will present and critique one paper 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 discussion in the end, and another group will critique, while all other students will submit 2 discussion questions for this paper. Students will sign up for paper presentation with discussion and Q&A in Week 2 after groups are formed. We have a detailed rubric on students' presentation and critique.

Paper Presentations and Discussion Facilitation Grading Rubric		
Requirement	**Percent of Assignment Grade**	**Final Grade Points**
30-minute presentation of selected paper	50%	10
10-minute critiques discussion	25%	5
10-minute facilitate discussion	25%	5

c. Paper Questions & Discussion

Paper Discussions activity will comprise 10% of your grade (10 points). Students are expected to actively participate in the weekly paper discussion presented by your fellow students in the course. That week's student presenter will facilitate the discussion, but it is important for fellow students to use this opportunity to explore their questions related to the week's content on the paper presented. There will be 5 discussions in total based on student presented papers. Students will submit 2 discussion questions based on the assigned paper by the **Tuesday 11.59 (EST)** via Canvas. These questions will be shared with the week's presenting student. Paper Discussion Questions will be graded based on the relevance of submitted questions to the week's paper and demonstration of critical thinking about the content of the week's paper.

Paper Discussion Questions Grading Rubric		
Requirement	**Percent of Assignment Grade**	**Final Grade Points**
2 Relevant Discussion. Questions submitted to instructor (5 in class discussions – 1 presentation - 1 critique) x 2 discussion questions = 6 total questions; each discussion question will count 0.8 point of the final grade)	100%	5

d. Admin & Attendance

Administrative assignments (e.g., Introduce yourself discussion, Microsoft Teams) and attendance to synchronous sessions will comprise 5% of your grade (5 points).

e. **Final Project**

The Final Project will comprise 50% of your grade (50 points). This project report will be 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. This proposal 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 integration of core knowledge of multiple modalities and machine 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 into their research program. Font must be Arial 11 single spaced with no more than 1-inch margins on all sides.

Category	Requirements		Percentage	Points
Report (50%)	Specific Aims: with at least 2 specific aims and 1 specified hypothesis per specific aim	1 page	10%	5
	Research Strategy: Significance, Innovation, Design and Methods sections	6 pages	15%	7.5
	Research Strategy: Preliminary Results		10%	5
	Integration of two or more modalities covered in the course into specific aims and research strategy (integration is defined as use of two or more method in the context of at least one specific aims/hypothesis and appropriate methodological and theoretical discussion in the research strategy)		10%	5
	Bibliography		5%	2.5
Code (10%)	Program runs well and produces expected results		10%	5
Present (30%)	Modality Presentation		10%	5
	Final Oral Presentation		20%	10
Milestone (10%)	Milestone 1: Modality Presentation Slides		5%	2.5
	Milestone 2: Revised Specific Aims & 3-page Research Strategy		5%	2.5
Award	(Extra Credit) Best and runner-up in Oral Presentation		+4%/+2%	+2/+1
Score	Total Points		(100+4)%	50+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:

- Applies to quiz, paper discussion questions, aims page, project milestone reports.
- Does not apply to paper presentation, modality presentation, project final presentation, or final project report, and final project code.
- First time late submission will be given a warning only. From the second time and 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 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/.

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 project partner). But everyone must turn in their own 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 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 regards 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 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.