AI-based Medical Image Acquisition & Analysis

BME 6938 Section 23321
Class Periods: M,W,F | Period 7 (1:55 PM - 2:45 PM)
Location: BLK 0315
Academic Term: Fall 2025

Instructor:
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Office Hours: Friday 12 – 1 pm, Malachowsky Hall 3117

Course Description

This 3-credit graduate-level course introduces students to the principles and applications of artificial intelligence (AI) in medical image acquisition and analysis. Topics include: (1) medical imaging modalities (CT, MRI, PET, X-ray, and ultrasound); (2) modern AI techniques such as convolutional neural networks (CNNs), transformers, generative models (GANs and diffusion models), and vision-language models; and (3) the application of AI to medical image processing tasks, including denoising, super-resolution, reconstruction, segmentation, registration, and classification. Emphasis is placed on real-world datasets, clinical integration, and emerging trends in medical imaging AI.

Course Pre-Requisites / Co-Requisites

Foundational knowledge in computer programming is needed to be successful in this course.

Course Objectives

This course aims to equip students with the knowledge and skills to apply modern AI techniques to medical imaging. By the end of the course, students will be able to explain the fundamentals of major imaging modalities (CT, MRI, PET, X-ray, ultrasound), understand core AI models (CNNs, GANs, transformers, diffusion, vision-language models), and apply them to key tasks such as image denoising, reconstruction, segmentation, and classification. Students will also gain experience working with real-world datasets and address issues related to clinical integration, interpretability, and ethical considerations.

Required Textbooks and Software

Required Textbook: None.
Required Software: Python, Pytorch.

Course Schedule

Note: **A**#: AI-related lectures; **M**#: Imaging modality-related lectures; **P**#: Image processing-related lectures.

Week	*Date*		*Lecture No. and Topic*
1	***Aug.***	22	**M0** - Course Introduction
2		25	**A1**- CNN
		27	**A1**- CNN
		29	**M1** – Radiography Fundamentals
3	***Sep.***	1	Labor Day (no classes)
		3	**M1** – Radiography Fundamentals
		5	Hipergator tutorial
4		8	**A2**- GAN
		10	**A2** – GAN */ **In-class quiz 1***
		12	**M2** – Mammography or (Pytorch demonstration)
5		15	**A3**- Transformer
		17	**A4**- Diffusion models
		19	**M3** - Computed Tomography
6		22	**A4**- VLM

		24	**A5**- VLM
		26	**M3** – Computed Tomography
7		29	**P1** – Image Denoising
	Oct.	1	**P1** – Image Denoising / ***In-class quiz 2***
		3	**M4** - Magnetic Resonance Imaging
8		6	**P2** – Image Super Resolution
		8	**P3** – Image Segmentation
		10	**M4** - Magnetic Resonance Imaging
9		13	**P3** – Image Segmentation
		15	**P4** – Image Classification & Detection
		17	Homecoming (no classes)
10		20	**P4** – Image Classification & Detection
		22	**P5** – Image Reconstruction / ***In-class quiz 3***
		24	**M5 -** Positron Emission Tomography
11		27	**P5** – Image Reconstruction
		29	**P5** – Image Reconstruction
		31	**M5 -** Positron Emission Tomography
12	***Nov.***	3	**P6** – Rigid Image Registration
		5	**P6** – Nonrigid Image Registration
		7	**P6** – AI-based Image Registration
13		10	**P6** – Synthetic Image Generation
		12	**P6** – Synthetic Image Generation / ***In-class quiz 4***
		14	**M6** – Ultrasound Imaging
14		17	**P7** – Explainability of Medical AI models
		19	Guest lecture (TBD)
		21	**M6** - Ultrasound Imaging
15		24	Holiday Week (No classes)
		26	Holiday Week (No classes)
		28	Holiday Week (No classes)
16	***Dec.***	1	Project presentation
		3	Project presentation

In-class Quiz (closed book): Four in-class Quizzes will be given during the semester. More information will be given prior to the first Quiz. Make-up Quiz will only be considered for exceptional circumstances and will be implemented by the instructor on a case-by-case basis. Notice of absence must be given to the instructor prior to each exam.

Homework: Homework assignments will include both programming tasks and calculation tasks. Late submissions will be accepted up to 4 days after the deadline. Late submissions will receive a maximum of 70% of the original score.

Final Project: Student groups are asked to select a topic related to a specific disease and an image processing/aqusition task. By leveraging the open-access clinical data (e.g., challenges organized by different societies, TCIA, ADNI), the group will develop an AI method to address the issue through image processing methods. The group will do a project presentation on it and submit a final report. The report template will be provided with detailed contents in each section. Final documents are due for assignment upload on **Wednesday, December 3rd**. **All submissions will be subject to plagiarism review using Turnitin.**

Evaluation of Grades

Grading Policy	Total Points	% of Final Grade	Exams / Due Dates
Homework Assignments	100 each	25%	
Class Attendance		5%	
Quiz 1	100	10%	**Wednesday – September 10**
Quiz 2	100	10%	**Wednesday – October 1**
Quiz 3	100	10%	**Wednesday – October 22**
Quiz 4	100	10%	**Wednesday – November 12**
Final Project	100	30%	**Wednesday – December 3**

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Commitment to a Positive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

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 Coordinator
• HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
• Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

Academic Policies & Resources

Please refer to the following link for academic policies and campus resources: https://go.ufl.edu/syllabuspolicies.