

Medical Image Analysis

CAP 6516 Section 34ED

Class Periods: MWF, 4th Period 10.40am-11.30am

Location: MCCA 1142

Academic Term: Spring 2020

Instructor:

Name Baba C. Vemuri

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Office Phone Number : 352-294-6675

Office Hours: Mondays 2-3.30pm, office location: CSE E324

Teaching Assistant/Peer Mentor/Supervised Teaching Student: TBA

Please contact through the Canvas website

- Name, email address, office location, office hours

Course Description

Medical image formation, reconstruction mathematics (Fourier slice theorem, Abel, Hankel and Radon transforms), Compressed Sensing (MRI/CT), denoising filters, active 2D/3D models and segmentation, segmentation via Bayesian estimation, shapes and shape spaces, Image registration with application to uni- and multi-modal co-registration, diffusion MRI analysis, deep learning for image/shape classification.

Course Pre-Requisites / Co-Requisites

MAC 2312 or Equivalent, COT 4501 or equivalent, CAP5416 or equivalent and Proficiency in MATLAB or Python.

Course instructor will determine Equivalency.

Course Objectives

Students will learn and become proficient in image reconstruction methods using dictionary learning and sparse reconstruction methods; image analysis methods such as denoising, segmentation and shape representation methods; image registration methods (uni- and multi-modality registration); image classification methods using supervised and un-supervised learning methods.

Students will be required to present assigned research papers for in class individual presentations and a programming project involving coding and testing of a previously published algorithm from literature.

Required Textbooks and Software

- None

Recommended Materials

- Title : Medical Imaging Signals and Systems
- Author: Jerry Prince and Jonathan M. Links
- Publication date and Publisher : 2006, Prentice Hall.
- ISBN Number : 0-13-06-5353-5

- Title: Mathematical Problems in Image Processing
- Author: G. Aubert and P. Kornprobst
- Publication: 2002, Springer
- ISBN Number: 0-387-95326-4

Course Schedule

- Week 1: Fourier and Radon transform, Fourier Slice theorem
- Week 2: CT Reconstruction using filtered back projection
- Week 3: MR image formation and reconstruction
- Week 4: Shannon's sampling theorem and sub-Nyquist sampling
- Week 5: Compressed Sensing and Reconstruction
- Week 6: Denoising Filters (PDE based)
- Week 7: Image segmentation
- Week 8: Diffusion MRI analysis
- Week 9: Image registration
- Week 10: Deep Learning and Image classification
- Week 11: Class Presentations
- Week 12: Class Presentations
- Week 13: Class Presentations
- Week 14: Class Presentations
- Week 15: Class Presentations

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is highly recommended since I will only use the text book as a guide but will be covering material drawn from research papers and other references, most of which will be posted on the class website. **Cell phones and laptops must be turned off** during class hours. Late homeworks will not be accepted. For programming assignments, one day late will be allowed at a penalty of 15% of the grade and two days at 30% of the grade. No programming assignments will be accepted later than two days beyond the deadline. Make up exams will only be permitted in cases of illness or family emergencies but will require documented proof.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Programs (4)	100 (each)	30%
Class Presentations	100	30%
Programming Project	100	40%
		100%

Grading Policy

Grading will be relative and on a curve.

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.ua.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.ua.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>

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://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

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