CAP6516: Medical Image Analysis
Schedule: MWF, 4th Period
Location: NRN 0331

Pre-requisites: Multivariate Calculus, Linear Algebra, proficiency in MATLAB including methods to display images on the screen of your laptop/desktop.

What will you learn from this course: At the end of the course, you will be able to write programs to denoise medical images, segment them into meaningful parts, achieve reconstruction of medical image data from sparse sampling, register/align uni-modal and multi-modal medical image data sets (e.g., MR and CT etc.), dimensionality reduction PCA and PGA, diffusion MRI data analysis. You will get an idea of what the MR Scanners look like from a trip to the McKnight Brain Institute.

Instructor: Professor Baba Vemuri
Office Location & email: CSE 324, vemuri@cise.ufl.edu
Class Web Site: www.cise.ufl.edu/class/cap6516sp17/
Office hours: M: 1.30-3.00pm or by appointment (to be set up via email).

Texts and Recommended Reading:
There is NO text book for this class. However, there are several references and they are:

1. Medical Imaging Signals and Systems, by Jerry Prince & Jonathan Links, Publisher: Prentice Hall.
2. Digital Image Processing, by Rosenfeld and Kak (Vol. 1); Publisher: Academic Press.
7. Other Material: Papers from the following journals, IEEE TMI, MedIA, PAMI, IJCV, JMIV, and IEEE TIP; Some of these material will be handed out in class.

Course Outline: Topics Covered
Medical image formation, reconstruction mathematics (Fourier slice theorem, Abel, Hankel and Radon transforms), Compressed Sensing (MRI/CT), PDE-based denoising, active 2D/3D models and segmentation, segmentation via Bayesian estimation, shape priors, Image matching/registration with application to uni- and multi-modal co-registration, diffusion MRI analysis, dimensionality reduction using PCA and PGA for shape/image classification.

Grading
1. Presentations: 40% – All presentations must use multimedia (laptop-based).
2. Project: 60% – All projects will involve a short (at most 10 pages including figures and refs.) report and a live demo.
3. Your final grade will be based on a curve.

4. There will be no make ups for any of the assigned work unless the student has medical reasons for missing the deadlines. In this case, the student will be asked to furnish a letter from the attending physician.

**Other Policies**

- **Academic Honesty:** 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 ([http://www.dso.ufl.edu/scr/process/student-conduct-honor-code/](http://www.dso.ufl.edu/scr/process/student-conduct-honor-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. Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures. See [http://www.dso.ufl.edu/scr/procedures/honorcode.php](http://www.dso.ufl.edu/scr/procedures/honorcode.php)

- You are allowed to discuss hwk and programing problems with your colleagues in class but keep in mind that you MUST hand in your own solutions which must be distinct from those you consulted with.

- **Cell Phones:** Your cell phones MUST be switched off during the class period.

- **Students with Disabilities:** Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

- **UF Counseling Services Resources** are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include: UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, [http://www.counseling.ufl.edu/cwc/Default.aspx](http://www.counseling.ufl.edu/cwc/Default.aspx), counseling services and mental health services. Career Resource Center, Reitz Union, 392-1601, career and job search services. University Police Department 392-1111.

- **Software Use** All faculty, staff and student 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.

- **Instructor/Class Evaluation:** Students are expected to provide feedback on the quality of instruction in this course based on 10 criteria. These evaluations are conducted online at [https://evaluations.ufl.edu](https://evaluations.ufl.edu). Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at [https://evaluations.ufl.edu/results](https://evaluations.ufl.edu/results).
Tentative schedule of lectures

1. Fourier, Abel, Hankel transforms, sampling theorem.
2. CT reconstruction mathematics, back-projection.
3. Compressed Sensing
4. Image restoration via linear and nonlinear filtering.
5. Geometric active contours and image segmentation
6. Clustering and Bayesian segmentation methods.
7. Matching and image registration.
8. Shape/image classification.
9. Diffusion MRI analysis