BME6938: Introduction to Biomedical Image Analysis and Imaging Informatics

1. Catalog Description (3 credits)
We are living in a revolutionary age, witnessing the next-generation of biological and medical image and information emerged in astounding volume and rich formats. Nowadays images and videos are widely used in biological and medical research and clinical applications. Manual image analysis and management is extremely time consuming, labor intensive, prone to errors, and not reproducible. The end goal for this class is for you to not only learn the scope and importance of the fundamental principles of utilizing computers to analyze and manage images automatically, but also get hands-on training in developing accurate biomedical image analysis algorithms and suitable imaging informatics tools to solve the computational problems in your research. This class would be suitable for a broad spectrum of engineering students who are interested in learning how to utilize informatics and computational methods to analyze biomedical images and videos (multiple dimensions, multiple modalities) in a quantitative, automatic, objective, and high throughput manner.

This is a graduate level course designed for students interested in learning biomedical image analysis and imaging informatics technology.

2. Pre-requisites and Co-requisites
Basic knowledge of programming (C++ and/or Matlab), statistics, linear Algebra, and probability

3. Course Objectives
At the end of the semester, students are expected to be able to:

• Obtain best practices in biomedical image computing for processing biomedical images to extract quantitative and automatic measurements.
• Apply the basic tools and software for building high throughput imaging informatics system
• Learn to collaborate with colleagues in the design, development, and implementation of research projects.

4. Instructor
   a. Office location: NEB 364
   b. Telephone: (352)-294-2228
   c. E-mail address: lin.yang@bme.ufl.edu
   d. Instructor website: http://www.bme.ufl.edu/labs/yang/
   e. Class Web site: Sakai
   f. Office hours: Tuesday 2:00 pm-3:00 pm, Thursday 3.00-4.00PM

5. Meeting Times
   • Tuesdays Period 8-9 (3:00 pm-4:55 pm) , Thursdays Period 9 (4:05 pm-4:55 pm)
   • Midterm Exam: Tuesday, March 10, 3:00 pm-4:55 pm, MAEB Room 229
• Final Project Presentation: Tuesday, April 21, 3:00 pm-4:55 pm, MAEB Room 229

6. Class Session
   BME6938

7. Meeting Location
   MAEB Room 229

8. Material and Supply Fees
   N/A

9. Textbooks and Software Required
   Course notes are developed and provided by the instructor, no textbook is needed.

10. Recommended Reading
    Recommended:
        • PACS and Imaging Informatics: Basic Principles and Applications, H. K. Huang, Wiley-Liss, 2004
        • Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2006
        • Handbook of Medical Imaging Volume 1, 2 and 3, SPIE Press-International Society for Optical Engine, 2000

11. Course Outline (12 weeks)
    We will introduce the state-of-the-art knowledge to understand, develop, and apply existing methods and software to handle biomedical image data. The topics in this class will include:
        • Introduction to basic imaging modalities such as MRI, CT, ultrasound, X-ray, Microscopy.
        • Introduction to basic linear algebra that is required for understanding biomedical image analysis.
        • Image processing technologies, such as filtering, mathematical morphological operations, etc.
        • Some machine learning topics for biomedical image analysis (unsupervised learning: such as clustering using K-means and mean-shift, linear dimension reduction such as PCA, nonlinear dimension reduction, supervised learning such as naïve Bayesian, decision tree, support vector machine, etc.)
        • Some important biomedical image analysis topics including: Segmentation, registration, object detection and recognition, and object tracking.
        • Introduction to imaging informatics, including building multimedia database and basic image searching and retrieval technologies.
        • Selected hot topics for high throughput computing and its application in biomedical image analysis: Multicore processor, graphic processing unit, Cloud, and Grid.

12. Attendance and Expectations
    Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.
13. Grading
Final grade is calculated as:
- Homework 30%: Three assignments and each will be 10%
- Midterm 10%
- Student paper presentation 10%
- Final team project 35%
- Final team project presentation 15%

14. Grading Scale
Grades may be curved. Undergraduate students, in order to graduate, must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. Graduate students, in order to graduate, must have an overall GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

- A: 100-95
- A-: 94-90
- B+: 89-87
- B: 86-83
- B-: 82-80
- C+: 79-77
- C: 76-73
- C-: 72-70
- D+: 69-67
- D: 66-63
- D-: 62-60
- F: 59-0

15. 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 (http://www.dso.ufl.edu/sccr/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/sccr/procedures/honorcode.php

16. Accommodation for 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.
17. **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

18. **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.

19. **Instructor 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). “