Course Number: CSC 621
Course Title: Biomedical Imaging and Analysis
Number of Credits: 3
Schedule: Three hours of lecture/discussion per week.
Prerequisite: a grade of C or better in CSC 510 and MATH 325

Catalog Description
Introduction to medical and biological imaging, imaging physics, 3D imaging, image formats, visualization. Basic digital image processing and analysis, filtering, registration, segmentation, quantification, performance evaluation. This course is paired with CSC 821. Students who completed CSC 821 may not take CSC 621 for credit.

Expanded Description
(1 week) Introduction to imaging in biology and medicine, history of biomedical imaging

(1.5 weeks) Survey of imaging methods
biological applications: microscopic imaging, microarray imaging
3D imaging, X-ray, CT, MRI, PET, ultra-sound

(1 week) Imaging standards, databases, image formats: DICOM, Analyze

(1 week) Visualization: color spaces, 3D cross-section viewing, 3D volume rendering

(1 week) Introduction to digital image processing, sampling, quantization, image noise

(1 week) Image filtering: convolution, smoothing, sharpening, background removal

(1 week) Advanced processing, edge detection, morphological operations

(1.5 week) Image registration: feature-based registration, mutual information maximization

(1.5 week) Image segmentation: thresh-holding, advanced algorithms

(1.5 week) Image quantification: connected-component analysis, change analysis, statistical features, classification

(1 week) Performance validation: ground-truth, statistical performance analysis

Course Objectives and Role in Program
The objectives of this course include:
- Comprehensive overview of basic topics in biomedical imaging and analysis.
- Through project work, develop deeper knowledge of a specific biomedical imaging and analysis application.

- Through in-class student presentations, develop public speaking skills

Students will engage on hands-on collaborative and **mentored** project for analyzing biomedical data. **The in-class presentation of the project result can serve to fulfill the departmental oral presentation requirement toward a completion of a Bachelor of Science degree.**

Learning Outcomes

At the end of this course students will

- Know and understand basic concepts related to biomedical imaging and analysis including various imaging methods, image processing algorithms and performance evaluation techniques
- Know the basics and role of digital image processing in major biomedical applications
- Experience developing software for biomedical image analysis by utilizing existing libraries and descriptions of algorithms on the internet.
- Learn about oral presentation skills
- Learn about teamwork skills

Method of Evaluation

Student learning will be evaluated on the basis of

- Completeness and quality of final project work (**40%** of the grade)
- Completeness and quality of assignments (20% of the grade)
- Grade on midterms (**40%** of the grade)

Assignments: there will be regular quiz and/or homework.
Midterms: there will be two midterms
Final Project: students will engage on a group project mentored by a graduate student or undergraduate volunteer, present results in class individually, and submit a written report of the results.

Students will be evaluated on their ability to devise, organize and present complete solutions to problems. Solutions need to be presented in a neat and organized way; cryptic answers or untidy assignments will not be graded. Complete answers to all problems are required; a correct answer with no reasoning or with wrong reasoning will result in **partial** credit

The grade distribution is as follows: A (100% - 92.5%), A- (92.4%-90%), B+ (89.9% - 87.5%), B (87.4% - 82.5%), B- (82.4% - 80%)%), C+ (79.9% - 77.5%), C (77.4% - 72.5%), C- (72.4% - 70%), D+ (69.9% - 67.5%), D (67.4% - 62.5%), D- (62.4% - 60%), F (59.9% - 0%).

Required Textbooks

Introduction to Biomedical Imaging, A. Webb, IEEE Press. 2003
Digital Image Processing, R.C. Gonzalez and R.E. Woods. Prentice Hall. 2001

Written by: Kaz Okada (Feb 5, 2009)