PSYC 425
Functional Imaging of the Human Brain
Spring, 2015

Class Number: 52584R
Instructors: Professor Bosco Tjan (SGM 1017, 213-821-2954, btjan@usc.edu)
Class Time: 10:00 – 11:50 pm, Tuesdays and Thursdays (*lectures / labs may run overtime)
Office Hours: noon – 1:30 pm, Wednesdays
Location: DNI Conference Room
TAs: We do not have any officially assigned TAs. There are two volunteers, whom you may consult: Mr. Jared Gilbert (on lab exercises and scanner operations; Jared is the MR Technical Assistant of DNI), and Dr. Nihong Chen (on experimental design and data analysis; Nihong is a postdoc in Bosco's lab)

Required Textbook: *Functional Magnetic Resonance Imaging,* (3nd Ed.) by S. A. Huettel, A. W. Song, G. McCarthy, Sinauer Associates, Inc. Sunderland, MA, USA (2014). [Yes, you need this book!]

Course Description: Noninvasive functional brain imaging techniques has revolutionized the field of cognitive neuroscience. This upper-level undergraduate course will introduce the students to the general techniques of functional magnetic resonance imaging and their applications in revealing the various perceptual and cognitive processes in a human brain. The course consists of lectures and labs, with hands-on experience in operating the state of the art Siemens 3T Prisma Magnetic Resonance Imaging system.

Course Requirements: The course consists of lecture and lab components. Students are required to pass safety training and participate in several group projects. There will be three mid-terms (no final, but you must be present during the scheduled final exam time for project presentation). Class grades will be assigned according to the following weights: Homework & Lab: 30%; Midterms I, II, III 15% each; Group Project with written report, 25%.

Grade Distribution: A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; F: <60%

Tentative Schedule (*Lectures/labs that are likely to run overtime)

1/12	(Tu) Lecture 1: Class logistics. fMRI, an introduction (Ch. 1) (Th) Lecture 2: Safety (Ch. 2). IRB. Tools and Unix commands (Please watch this video before class: https://www.youtube.com/watch?v=hbzRWQjA6kI)
1/19	(Tu) Lecture 3: Basic principles of MR signal generation (Ch. 3, you may skip the equations that I did not cover in class) (Th) Lecture 4: Hemodynamic activity, the BOLD signal and its relationship to neural activities (Chs. 6 & 7)
1/26	(Tu) Lecture 5: Spatial and temporal properties of the BOLD signal (Ch. 7) (Th)* Lab 1: Typical control-room workflow and scanning demonstration. (Two sessions: 10-11, 11-noon. Meet at DNI control room.)

2/2 (Tu, Th) Lab 2: BOLD Imaging (block and rapid-event-related designs). Four groups, four sessions, two sessions per day. Meet at DNI control room. [Labs may run overtime]

2/9 (Tu) Lecture 6: Experiment design (Ch. 9)
(Th) Review

2/16 (Tu) Lecture 7: fMRI data analysis (I): General Linear Model (Ch. 10)
(Th) **Midterm I (Lectures 1-6)**

2/23 (Tu) Lecture 8: Signal & noise of fMRI; functional data preprocessing (Ch. 8)
(Th)* DA 1: Introduction to fMRI data analysis packages (mostly FSL), general workflow, file management, anatomical image processing, functional image preprocessing.
(F) Final project proposal presentations

(*2/26 Last date to drop a class without 'W' on the transcript.*)

3/1 (Tu)* DA 2: Single-session GLM analysis. First result. Defining ROIs.
(Th) DA 3: Coregistration, standard space, atlas, multi-session fixed-effect GLM.

3/8 (Tu) Lecture 9: Group-level mixed effect analysis
(Th) DA 4: Group-level mixed effect analysis.

3/14 *Spring Break*

3/22 (Tu) Lecture 10: fMRI data analysis (II): ROI analysis, peri-stimulus time course, deconvolution design, and the statistical efficiency of a design
(Th) DA 4,5 I: ROI analysis, deconvolution

3/29 (Tu) DA 4,5 II: ROI analysis, deconvolution
(Th) Review

4/5 **(Tu) Midterm II (Lectures 6-10 and DA 1-5)**
(Th) DA 6: Cortical segmentation. Volume-surface registration. Surface-based visualization. Surface-based ROIs.

(4/10 Last day to drop with a mark of W.)

4/12 (Tu) Lecture 11: fMRI data analysis II: one brain, many coordinates.
(Th) Lecture 12: Basic principles of MR image acquisition/reconstruction (Ch. 4)

4/19 (Tu) Lecture 13: Basic principles of MR image acquisition/reconstruction (Ch. 4)
(Th) Lecture 14: Contrast mechanisms pulse sequences (I) (Ch. 5)

4/26 (Tu) Lecture 15: Contrast mechanisms pulse sequences (II) (Ch. 5)
(Th) Lecture 16: Useful tips on distortion, ghosting, susceptibility, BOLD sensitivity, and spatiotemporal resolution. (Ch. 8)
(F) Midterm III (take home, 24 hr turn around, work independently, Lectures 11-16, DA 6)

Final project presentation: Tuesday, May 10, 8:00 am – 10:00 am. (This is the scheduled time for final exam. You must be present to receive credit for the final project.)