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, Mondays and Wednesdays (*lectures / labs may run overtime)
Office Hours: noon – 1:30 pm, Tuesdays
Location: VPD 107
TA: Helga Mazyar (mazyar@usc.edu)
TA Office Hours: 2 – 3:30 pm, Wednesdays


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 midterms (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  (M) Lecture 1: Class logistics. fMRI, an introduction (Ch. 1)
       (W) 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   (M) MLK Day
       (W) Lecture 3: Basic principles of MR signal generation (Ch. 3)
1/26   (M) Lecture 4: Hemodynamic activity, the BOLD signal and its relationship to neural activities (Chs. 6 & 7)
       (W) Lecture 5: Spatial and temporal properties of the BOLD signal (Ch. 7)
       (F)* Lab 1: Typical control-room workflow and scanning demonstration. (Two sessions: 10-11, 11-noon. Meet at DNI control room.)

(1/30 Last date to add / drop without ‘W’ / change grade option)
(M, W) 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]

(M) Lecture 6: Experiment design (Ch. 9)
(W) Review

(W) Midterm I (Lectures 1-5)

(M) Lecture 7: fMRI data analysis (I): General Linear Model (Ch. 10)
(W) Lecture 8: Signal & noise of fMRI; functional data preprocessing (Ch. 8)

(M)* DA 1: Introduction to fMRI data analysis packages (mostly FSL), general workflow, file management, anatomical image processing, segmentation, cortical and subcortical templates
(W)* DA 2,3: Single-session GLM analysis. First result. Defining ROIs. Coregistration. Multi-session fixed-effect GLM.

(M) Lecture 9: Group-level mixed effect analysis
(W)* DA 4: Group-level mixed effect analysis. Review

Spring Break

(M) Lecture 10: fMRI data analysis (II): Peri-stimulus time course, deconvolution design, and the statistical efficiency of a design
(W) Midterm II (Lectures 6-9 and DA 1-4)

(M) DA 4,5 I: ROI analysis, deconvolution, multi-session fixed-effect GLM
(W) DA 4,5 II: ROI analysis, deconvolution, multi-session fixed-effect GLM.

(W)* Final (data analysis) project proposal presentations

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

(M) Lecture 11: fMRI data analysis II: one brain, many coordinates. DA 7: Surface-based ROIs. Surface-based deconvolution.
(W) Lecture 12: Functional “connectivity” (Ch. 11)

(W) Lecture 13: MR image formation and pulse sequences – a very brief introduction (Ch. 5)

(M) Lecture 14: Useful tips on distortion, ghosting, susceptibility, BOLD sensitivity, and spatiotemporal resolution. (Ch. 8)
(W) Lecture 15: Multi-voxel pattern analysis (Ch. 11), “mind reading”, and neural decoding.

(F) Midterm III (take home, 24 hr turn around, work independently, Lectures 10-13, DA 4-9)

Final project presentation: May 11, 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.)