Cognitive neuroscience methods

Cognitive neuroscience is an inherently multidisciplinary field, in that it includes (at minimum) neuroscience, cognitive and experimental psychology, biophysics, statistics, and (as a practical concern) computer science. Unlike courses that focus strictly on statistics, or those that cover functional magnetic resonance imaging (fMRI) from soup to nuts in a lecture-focused format, this course will focus on the following aspects of MRI: 1) statistical models, 2) experimental design, and 3) data analysis. Throughout we will emphasize hands-on applications through a weekly computer lab in which students will work through problem sets. This will allow students to learn practical skills from each other and the instructor.

Although this is not a complete syllabus, what follows are examples of topics that would be covered in this course (with a lecture and lab for each, so one topic per week):

Modeling of cognition:

1. Computational modeling of typical cognition
2. Computational cognitive neuropsychology

Structural MRI:

3. Lesion-symptom mapping
4. Analyzing gray matter differences using voxel-based morphometry and measures of cortical thickness
5. Diffusion tensor imaging

Functional MRI:

6. Blocked designs
7. Event-related designs
8. Factorial designs
9. Parametric designs
10. Functional connectivity
11. Effective connectivity
12. Multi-variate pattern analysis

Evaluation would be based on the weekly problem sets, a midterm project, and a final project. The final would consist of analyzing and reporting on a MRI dataset that has been made publicly available for research purposes, such as data from the Alzheimer's Disease Neuroimaging Initiative, or the Human Connectome Project.