Office Hours: Mondays 4 – 5:30, or by appointment. 337 Smith Hall. The best way to reach me is by email (william.graves@rutgers.edu) or in person right after class.

Course Overview: This graduate course offers students a chance to engage both broadly and deeply with key methods used in cognitive neuroscience. This inherently trans-disciplinary field 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 lab exercises. This will allow students to learn practical skills from each other and the instructor.

Learning Objectives: Upon successful completion of this course, students should be able to

- Apply and manipulate computational models of cognition
- Use structural MRI and behavioral data together to guide inferences about brain structure-function relationships
- Critically evaluate the usefulness of the different approaches to fMRI design and data analysis
- Formulate a hypothesis and test it using one or more of the methods covered in class.

Course Website: The current version of the syllabus (it may change, but I will announce if it does) and the readings will be available on Blackboard, http://blackboard.newark.rutgers.edu.

Course Requirements:

1. In each Monday class discussion session, a student will present and lead discussion of the assigned article. This does not mean that student must talk the entire time. Rather, he or she will, for example, elicit questions from the other students and seek clarification where needed. Students NOT leading the discussion must submit at least one discussion topic or question on the reading by email to the discussion leader and copy to william.graves@rutgers.edu. This must be done by 11:59 PM on the day before class.

2. Class participation will be weighted heavily. At minimum you must be present to participate in discussions, so attendance is mandatory. The best way to prepare for discussion is to read the article to be presented. To get the most out of this course, we will need insightful, cooperative discussion.

3. For labs, it is critical to read the material ahead of time. Consider the lab assignment as background reading for the lab session, just like the articles are necessary for the discussion sessions.
(4) For the final project, students will write a sample journal article, following the format of the *Journal of Cognitive Neuroscience*. The final project will be due in stages according to the schedule below, and can be related to any topic covered in the course.

**Assessment:**
Your final grade will be calculated as follows:
- Discussion topic/question email 5%
- Class attendance 5%
- Contribution to class discussion 5%

**Total participation:** 15%

Lab assignments (due at the beginning of the subsequent session): 15%

**Sample journal article:**

<table>
<thead>
<tr>
<th>Step</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample title and abstract</td>
<td>Rough abstract, 2/9; Final abstract, 2/23</td>
</tr>
<tr>
<td>First draft</td>
<td>Monday, 3/23, 9 am</td>
</tr>
<tr>
<td>Two peer reviews</td>
<td>Monday, 4/23, 9 am</td>
</tr>
<tr>
<td>Class presentation</td>
<td>Thursday, 5/4, in class</td>
</tr>
<tr>
<td>Response to reviews</td>
<td>Thursday, 5/7, 5 pm</td>
</tr>
<tr>
<td>Final draft</td>
<td>Thursday, 5/7, 5 pm</td>
</tr>
</tbody>
</table>

**Total article:** 70%

**Grading scale:**
- A: 100-90
- B+: 89-86
- B: 85-80
- C+: 79-76
- C: 75-70
- D: 69-62

**Academic Integrity:**
Students are expected to **do your own work at all times**. Those caught cheating, or who give the appearance of cheating, will be dismissed from class. The University and I take cheating very seriously. Students caught cheating may be suspended or expelled. To help you avoid this situation, please familiarize yourself with the University policy on academic integrity outlined here: [http://academicintegrity.rutgers.edu](http://academicintegrity.rutgers.edu).

**Notes:**
- The deadline to drop a course without penalty is **January 27, 2015**.
- The deadline to withdraw from a course with a W grade is **March 30, 2015**.
- If you need accommodation for a learning disability, I will need to see an official Letter of Accommodation from Disability Services ([http://robeson.rutgers.edu/studentlife/disability.html](http://robeson.rutgers.edu/studentlife/disability.html)). This helps me know the best way to help you.
- Tutoring, skills workshops, and writing assistance are available at the Rutgers Learning Center ([http://www.ncas.rutgers.edu/rlc](http://www.ncas.rutgers.edu/rlc)).

Data for the labs will come from several sources, including publicly-available databases such as OASIS ([http://www.oasis-brains.org/](http://www.oasis-brains.org/)) and the Human Connectome Project ([http://www.humanconnectomeproject.org/](http://www.humanconnectomeproject.org/)).
Schedule of Topics and Readings

Jan 22 Introductions and course overview
Assignments: (1) Unix tutorial for beginners (http://www.ee.surrey.ac.uk/Teaching/Unix/)
(2) Hands-on introduction to the “Emergent” neural network simulator
(https://grey.colorado.edu/emergent/index.php/Build_your_own_network)

Modeling of Cognition:

26 Computational modeling of typical cognition (discussion)

29 Computational modeling of typical cognition (lab)
Hands-on exploration of a spelling-sound network in Emergent:
https://grey.colorado.edu/CompCogNeuro/index.php/CCNBook/Sims/Language/Spelling_to_Sound

Feb 2 Computational cognitive neuropsychology (discussion)

5 Computational cognitive neuropsychology (lab)
Hands-on exploration of dyslexia modeling in Emergent:
https://grey.colorado.edu/CompCogNeuro/index.php/CCNBook/Sims/Language/Dyslexia

9 Lesion-symptom mapping (discussion)
NOTE: Rough abstract due in class

12 Lesion-symptom mapping (lab)
Short background article:

Hands-on tutorial for voxel-based lesion-symptom mapping:
http://www.mccauslandcenter.sc.edu/mricro/mricron/stats.html

16 Gray matter differences (discussion)

19  Gray matter differences (lab)
Hands-on exercise in VBM analysis using FSL software:
http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FSLVBM

23  White matter differences (discussion)
NOTE: Final abstract due in class

Special focus on correlation and regression.

26  White matter differences (lab)
Toy analysis of correlation and regression using |STAT (http://oldwww.acm.org/perlman/stat/).

Hands-on exercise in DTI analysis using FSL software:
http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FDT

*Functional MRI*

Mar 2  Blocked designs (discussion)

5  Blocked designs (lab)
AFNI practical, “Saturday morning” section.

9  Event-related designs (discussion)

12  Event-related designs (lab)
AFNI practical, “Sunday afternoon” section.

16 & 19, No Class, Spring Recess

23  Factorial designs (discussion)
NOTE: First draft of article due at 9 am
Special focus on ANOVA.

26   Factorial designs (lab)
     Script for assignment to be provided.

Toy analysis of ANOVA using |STAT.

30   No Class, CNS Meeting

Apr  2   Lab makeup day and open help session
     Note: Peer reviews due at 9 am

6    Parametric designs (discussion)
     Cerebral Cortex, 20, 1799-1815.

9    Parametric designs (lab)
     Script for assignment to be provided.

13   Functional connectivity (discussion)
     echo-planar MRI.” Magnetic Resonance in Medicine, 34, 537-541.

16   Functional connectivity (lab)
     Script for assignment to be provided.

20   Effective connectivity (discussion)
     Chen et al. (2011) “Vector autoregression, structural equation modeling, and their synthesis in
     neuroimaging data analysis.” Computers in Biology and Medicine, 41, 1142-1155.

23   Effective connectivity (lab)
     Hands-on practice with AFNI 1dSVAR software:
     http://afni.nimh.nih.gov/sscc/gangc/SVAR.html (data and assignment to be provided)

27   Multi-variate pattern analysis (discussion)
     NeuroImage, 45, S199-S209.

30   Multi-variate pattern analysis (lab)
     The Princeton MVPA Toolbox tutorial in Matlab with AFNI images:
     https://code.google.com/p/princeton-mvpa-toolbox/wiki/TutorialIntro

May  4   Class Presentations

Final Article/Response to Reviews due: Thursday, May 7, 5 pm