NEU 366M – Quantitative Methods in Neuroscience
The University of Texas at Austin
Fall 2014
T/TH 12:30 pm – 2 pm
PAR 208

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Course content and aims
This course is aimed at providing a broad introduction to basic mathematical and computational tools central to the analysis of neural systems, with examples from neuroscience to motivate the use of various techniques. We will cover specific topics from linear algebra, differential equations, filtering, correlation, probability and inference, with an emphasis on applications to neuroscience. The goal is to help develop a level of intuitive and practical comfort with quantitative methods, so that you are able to implement analysis, programming and visualization of complex data – a skill that is increasingly important in neuroscience in particular and scientific inquiry in general.

Prerequisites
Calculus (credit in Mathematics 408D or 408M), and Neuroscience 325 or 325H; or permission of Instructor.

Textbook

Software
We will use the mathematical programming language MATLAB for in-class demonstrations and homework assignments. MATLAB is commonly used for scientific analysis of data across the physical and biological sciences, including for neuroscience research and laboratory work. The College of Natural Sciences at UT Austin has purchased a campus-wide site license for MATLAB, and in principle it can be installed and run on any UT Austin-owned computer. You can access computers with MATLAB pre-installed in the following computer labs. You will need to logon to the computers with your UT EID and password.
**SEA 2.116:** 16 seats. These times are not exclusively reserved for our class, use is first-come, first-served. Unlisted times have been reserved for computer lab sessions by other classes, and the room will not be available for our use:

- M: 3-6pm
- T/Th: 9-11am / 12:30-4pm
- F: 9-1pm / 3-6pm

**PCL (Perry Castaneda Library):** 150 seats at entry level, first-come, first-served. Hours can be found here: [http://www.lib.utexas.edu/about/hours/pcl](http://www.lib.utexas.edu/about/hours/pcl)

If you would like to install MATLAB on your personal computer, you will have to purchase the software; the student version of MATLAB has full functionality and costs considerably less than a regular (non-student) version. A freeware program called Octave has much (but not all) of the functionality of MATLAB, and uses the same commands and programming environment. You are free to try it, but I recommend that you first become familiar with MATLAB. An important scientific programming alternative is Python, which is also freeware. Python is very versatile, but can perhaps be less easy to use at the beginning, so we will focus on MATLAB. You are encouraged to try various alternatives for exposure and future use, but for uniformity and grading purposes, homework should be submitted in MATLAB (note that code written for Octave and Python can typically be easily ported into Matlab).

**Labs/Tutorials**

We have reserved the computer lab room SEA 2.122 for only our class at the following time: F 10:30-12pm. Any MATLAB tutorials as well as the TA’s regular weekly office hours for Friday will be held in this room. Note that unlike SEA 2.116 (above), which is unlocked during building hours, access to this lab room is by prox card so it can only be used at the scheduled lab hours when the TA is there to open the door for you.

**Grading**

There are three components to your grade: problem sets, one midterm exam, and a final project or exam. The breakdown will be as follows:

- Problem sets 60%
- Midterm Exam 20%
- Final 20%

This course will use +/-grading, and grades will be assigned on a curve as needed.

**Course-related materials**

Course-related materials, such as a copy of this syllabus, handouts, readings, homework assignments, slides, etc., will be posted on the course website: [http://clm.utexas.edu/fietelab/QuantNeuro/QuantNeuroWebpage2014.html](http://clm.utexas.edu/fietelab/QuantNeuro/QuantNeuroWebpage2014.html)

**Homework: Problem Sets**

There will be weekly problem sets, for a total of about 11 (give or take a couple) over the
semester. Homeworks will be distributed Tuesdays during class and will be due at the beginning of class the following Tuesday. Allow enough time to do the problem sets and begin well in advance: the homeworks will take about 12 hours of work each.

You are allowed and encouraged to discuss and collaborate on the homework with other students in the class. On every submitted homework, you are required to note the names of those you collaborated/discussed with. After collaborative discussions and derivations, the actual programming and writing out of solutions must be done entirely by yourself. Copying of code will result in a loss of credit for all involved individuals.

There will be a 25% deduction if you hand in the assignment one day late and a 50% deduction for two days late. Assignments will not be accepted for grading if they are more than two days late.

**Final Project or exam**
The final will involve either a project (like a larger, more in-depth homework set), or a sit-down in the final exam period.

**Office hours**
The TA and I are available during posted office hours or at other times by appointment. The most effective way to request an appointment outside of normal office hours is to suggest several times that work for you. I would suggest getting in touch with a message like the one below:

Dear Professor Fiete,

I’d like to request a meeting with you outside of regular office hours this week. I’m available anytime Thursday, or on Friday between 9am – 11am and 2pm – 4.

Thank you,

Jane Doe

**Email policy**
Please address all questions related to course material to me or the TA, in class, during one of our office hours, or by arranging a meeting with either of us outside office hours. Such questions are best answered in person, and we will not answer such questions over email. Please reserve email for questions with yes/no answers only, to alert us of any error or ambiguity you encounter on the problem sets, or to request a meeting times if you cannot make the regular office hours. Neither the TA nor I will discuss grading issues per email. According to state law and UT regulations, all grading information must be kept confidential, and email is not a confidential communication medium. If you have concerns about your grade, talk to me or the TA in office hours.

**Religious holidays**
A student who misses classes or other required activities, including examinations, for the observance of a religious holiday should inform the instructor as far in advance of the
absence as possible, so that arrangements can be made to complete an assignment within a reasonable time after the absence.

**Academic honesty**
I expect students to behave with integrity. Students found cheating on an exam or assignment will receive a score of zero for that exam or assignment, and may be subject to additional disciplinary action. For more information on the University of Texas scholastic dishonesty policy, see the General Information Catalog.

**Students with Disabilities**
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641.

**How to succeed in this class**
You will succeed in this class if you follow these recommendations:
1. Attend all lectures and computer tutorials/labs. Participate in in-class activities.
2. Don't give up too quickly. This is a problem-solving class, not a memorization class. The only way to successfully solve problems is to keep trying, even if you are not sure anything you do makes sense. Until you have tried ten different approaches, you haven't tried very hard.
3. Don't do your homework at the last minute. It is very common that we cannot solve a problem on one day, but the next day everything becomes clear. Our brain has worked on the problem in the background and has found the solution. This mechanism will only work if you start early and give your brain time to process the material. Programming problems will involve debugging and testing, which can also take some iterations and time.
4. Come prepared to class. Read up on the covered material in your textbook, when relevant.

**Lecture Schedule**

Week 1: Classes begin mid-week. Preliminaries and introduction to linear algebra.

**8/29:** Computer Lab Tutorial Part I: Matrix computation, how to open MATLAB, writing code, doing matrix operations, plotting, etc.
11am-12pm or 4-5pm @ SEA 2.122 (Choose one of these two slots.)

Week 2: 9/1-9/5 Linear algebra basics II. Linear regression.

*Homework 1* assigned.

**9/2:** Computer Lab Tutorial Part II: MATLAB conditional statements, loops, functions, more plotting and matrix operations.
6-7pm or 7-8pm @ SEA 2.122 (Choose one of these two slots.)

**9/5:** Computer Lab Tutorial Part III: MATLAB linear algebra basics including
eigenvalues and eigenvectors/review/question and answer.
4-5pm or 7-8pm @ SEA 2.122 (Choose one of these two slots.)

Week 3: 9/8-9/12  Homework 2 assigned.
Week 4: 9/15-9/19  Homework 3 assigned.
Week 5: 9/22-9/26  Homework 4 assigned.
Week 6: 9/29-10/3  Homework 5 assigned.
Week 7: 10/6-10/10
Week 8: 10/13-10/17  Midterm  Homework 6 assigned.
Week 9: 10/20-10/24  Homework 7 assigned.
Week 10: 10/27-10/31  Homework 8 assigned.
Week 11: 11/3-11/7  Homework 9 assigned.
Week 12: 11/10-11/14  Homework 10 assigned.
Week 14: 11/24-11/28  Thanksgiving week – 1 class day only.
Week 15: 12/1-12/5  Last class week

Final: Tuesday December 16, 9 am – noon