CS T680 - Computational Neuroscience
Course Syllabus
Summer 2022

General Information

Location: 3675 Market Street, room 1053,
Time: Wednesdays, 6:00 - 8:50 PM
The class will be broadcast live via Echo360 at the same time for the online section. You can access the online class as well as lecture recordings via Echo360 link on the Blackboard.

Lecture slides and announcements will be posted on Drexel's Blackboard Learn site at http://learning.drexel.edu.

To submit assignments, student needs to create an account at www.gradescope.com, and to join the class using entry code: **D5W7ZZ**

Contact

The professor for this course is Yusuf Osmanlioglu,
Email: yo42@drexel.edu
Phone: 215-895-1578
Office: 3675 Market St. 1145

Tentative office hours: Tue. 6:00pm – 8:00pm (contact the instructor for meetings beyond these hours)

Objectives

This course is intended as a broad graduate-level introduction to computational neuroscience, with a special focus on brain connectivity analysis and network neuroscience. Main goal is to introduce this rapidly developing domain of medical research to students coming from a computing background. After taking the course, the student will become prepared for a postgraduate level research experience in the burgeoning field of connectomics.

Prerequisites

No specific prior knowledge is necessary, but some exposure to graph theory at the undergraduate level and some general mathematical background, especially on linear algebra are assumed. You should have fluency in Python, MATLAB, or R (C/C++ can also work, although would make it a bit challenging for you).

Outline

We will cover the following topics:

- From raw MR data to brain graphs: data processing

- Connectomics at micro-meso-macro scale
- Mesoscale brain network properties, centrality and hubs in brain, rich clubs
- Motifs, small world, network economy, and modularity in brain networks
- Statistical analysis of connectomes, null models, generative network models
- Applications of machine learning and deep learning on connectomics
- Communication in the brain: structure-function coupling in connectomes
- Connectomics in the analysis of brain diseases and disorders: Traumatic brain injury, autism, neurosurgical planning
- Connectomics in development and aging

Expected Work

The course has three major components: weekly reading assignments, term project, and peer reviews .

1. **Readings:** You will be assigned one journal article every week to be read and summarized in 1 page before the class. Your summary should include the main highlights of the paper, and include a brief review of your opinion about the study.
2. **Term Project:** There will be a term project with 4 milestones, where you will do connectomic analysis. You can either pick a research paper to replicate its results and then expand it, or design your own study. Milestones will be as follows:
    a. Week 3: Present project idea and background
        i. find a problem and a data set, write a 2 page report stating the problem, as well as providing a background from the literature. Report should have 1 figure that visually conveys the message of the project.
    b. Week 5: Preliminary data analysis results report
        i. Do standard graph theory measures as well as more advanced analysis by using methods such as linear models, machine learning, deep learning etc.
        ii. 3 page report with 2-3 figures
    c. Week 7: More advanced data anlysis report
        i. Do analysis using methods such as linear models, machine learning, deep learning etc.
        ii. 3 page report with 2-3 figures (results should be different than the report 2)
    d. Week 10: Final results report
        i. in a paper format, with intro, results, and discussion
        ii. Results section should contain results from report 2 and 3
        iii. Should be a 6 page paper
    e. There will be project presentations at week 10 in class.
3. **Peer review:** For each report, you will review the report of one of your friend's, and write a 1 page review to give feedback to your friend.

Grading

1. Attendance: 10%
2. Weekly article reviews: 10%
3. Term project:

Report 1: 10%
Report 2: 15%
Report 3: 15%
Report 4: 20%

4. Peer review: 20%

We will apply "**self grading**" (which is also known as ungrading) in this course, which means, the instructor will give qualitative feedback for each assigmment/report, and the student will improve their reports for the next round. At the end of the term, every student will suggest a letter grade for their effort along with a page of their justification as to why they would give themselves such a letter. If the instructor agrees with this judgement, it will become the student's final letter grade. If the instructor does not agree with the justification, and thinks that the letter grade should be higher or lower, a one-on-one meeting will be held between the instructor and the student to re-evaluate the final letter grade.

Textbook

Fornito, A., Zalesky, A. and Bullmore, E., 2016. *Fundamentals of brain network analysis*. Academic Press. ISBN-13: 978-0124079083, ISBN-10: 0124079083
Available at Amazon
Note: You don't have to buy the textbook as the content of the lecture slides will cover a large portion of the material presented in the book. However, it is a very good reference text for the subject matter, and might be a good future investment if you are planning to work in the domain.

Academic Honesty Policy

The CCI Academic Honesty policy is in effect for this course. Please see the policy at http://drexel.edu/cci/resources/current-students/undergraduate/policies/cs-academic-integrity/.

You must be the sole original author of all assignments and examination solutions in their entirety, unless the instructor explicitly instructs you to do otherwise in written directions on an assignment or exam. Academic Honesty Violations will be reported to the University. Punishment will be determined by the severity of the incident. Punishments include, but are not limited to,

- Zero on Assignment/Exam Violation took place on
- Failing grade for class
- Deduction of one letter grade

The standards for originality in a program are similar to those of other written works. Programs by different authors show clear and substantial differences as judged by most criteria, including but not limited to: choice of variable and procedure names, line spacing and indentation, choice of program structure, choice of algorithms, ordering of modules, module design, and ordering and choice of instructions. The original author of an assignment can explain each detail and how they came to create it on their own.

It is your responsibility to avoid violating the university's policy. If you are unclear as to what the policy means in a particular situation, ask the instructor for clarification before you hand anything in.

University Policies

In addition to the course policies listed on this syllabus, course assignments or course website, the following University policies are in effect:

- Computer/Software Help provided by iCommons: https://drexel.edu/cci/current-students/icommons/
- Academic Honesty: http://www.drexel.edu/provost/policies/academic_dishonesty.asp
- Judicial Affairs Academic Integrity: http://drexel.edu/studentlife/community_standards/facultystaff/integrity/
- Official Final Exam Schedule: http://www.drexel.edu/registrar/scheduling/exams/
- Students with Disability Statement: http://drexel.edu/oed/disabilityResources/overview/
- Course Drop Policy: http://www.drexel.edu/provost/policies/course_drop.asp
- Drexel Student Learning Priorities: http://www.drexel.edu/provost/irae/assessment/outcomes/dslp/
- The instructor may, at his/her/their discretion, change any part of the course during the term, including assignments, grade brakdowns, due-dates, and the schedule. Such changes will be communicated to students via the course web site Announcements page. This page should be checked regularly and frequently for such changes and announcements. Other announcements, although rare, may include class cancellations and other urgent announcements.

Appropriate Use of Course Materials

It is important to recognize that some or all of the course materials provided to you are the intellectual property of Drexel University, the course instructor, or others. Use of this intellectual property is governed by Drexel University policies, including the IT-1 policy found at: https://drexel.edu/it/about/policies/policies/01-Acceptable-Use/ Briefly, this policy states that all course materials including recordings provided by the given prior written approval by the University. Doing so may be considered a breach of this policy and will be investigated and addressed as possible academic dishonesty, among other potential violations. Improper use of such materials may also constitute a violation of the University's Code of Conduct found at: https://drexel.edu/cpo/policies/cpo-1/ and will be investigated as such.

Recording of Class Activities:

In general, students and others should not record course interactions and course activities in lecture, lab, studio or recitation.

Students who have an approved accommodation from the Office of Disability Resources to record online lectures and discussions for note taking purposes should inform their course instructor(s) of their approved accommodation in advance. The recording of lectures and discussions may only be carried out by the students enrolled in the class who have an approved accommodation from Disability Resources

with their instructors' prior knowledge and consent. Students with approved accommodations may be asked to turn off their recorder if confidential or personal information is presented.

If a student has any comments, concerns, or questions about provided class materials and/ or recording, talk to your course instructor first. If this does not resolve the issue, you can also reach out to the Department Head, and use the process described for a grade appeal to move your concern forward. The process described for grade appeals can be found at: https://drexel.edu/provost/policies/grade-appeals/