ISCI 490 101: Modern Methods in Neuroscience
2017W Term 2
Tuesday/Thursday 4:00-5:30pm, LSK 464
Course Coordinator: Jasmyne Kassam
Faculty Sponsor: Jason Snyder

Course Description

How do we know what we know about the brain? How can we know even more? These are the defining questions behind the Modern Methods in Neuroscience seminar.

Neuroscience is one of the most rapidly growing and exciting fields of the 21st century. However, it's also incredibly diverse, as it incorporates methods from across all the sciences. A molecular geneticist studying Drosophila mutants and a physicist analyzing MRI scans are both technically "doing neuroscience", but their work couldn't be more different. This seminar aims to understand the scientific rationale behind the work of both these scientists (and many others), and how their research questions and approaches relate to one another. More broadly, students in this seminar will explore cutting-edge neuroscience techniques that borrow from biology, chemistry, physics, and computer science to address broader questions about the brain. We will be discussing each technique's scientific basis, research potential, and broader implications for society.

Course Structure

The course will be broadly split into 2 parts, each approximately 5 weeks long:

Part 1 will focus on cellular and molecular methods used to visualize individual neurons and the connections between them in animal models, particularly methods developed in the past 10 years. This half of the course will be more biological, drawing heavily from genetics, cell biology, chemistry and biotechnology.

Part 2 will focus on imaging methods that have been applied to examine the structure and function of the human brain. This half of the course will draw more from physics, computer science, and psychology. While the specific techniques discussed will not be quite as new as the ones from Part 1, we will center our discussion around new modifications of the techniques as well as their clinical and societal implications.

Part 1 and Part 2 each consist of multiple modules, each of which focuses on a different technique or approach. Each module will span 1-2 classes (see "Schedule" below).

Each module will begin with a 20-minute overview presentation from one of the students in the class that summarizes how the technique works and gives some basic context. Then, another student will briefly present and facilitate a class discussion on a reading that either extends the technique presented or applies it to answer a specific question. By the end of the 25-30 min discussion, the class should have explored the technique in more depth and reached a consensus on a key advantage or limitation. So, a 1-class module

would typically include 1 overview presentation and 2 reading presentations, with longer modules offering an opportunity for extra readings. For a particular module, a guest speaker or lab field trip could replace any one of these components.

The readings for this course will be scientific journal articles, which will ensure the seminar's academic rigor. All readings will fall into one of the following 3 categories:

A) Foundation Papers
   The defining paper for a module, i.e. the paper in which a technique was first introduced. These papers will be covered as part of the overview presentations.
   Ex: Chen, F., Tillberg, P. W., & Boyden, E. S. 2015. Expansion microscopy. *Science* **347**, 543-548.

B) Extension Papers
   Present a new version of a technique, or a new perspective (i.e. highlight a limitation). Will be assigned reading. Mix of pre-determined and student-chosen papers.
   Ex: Ku, Taeyun, et al. 2016. "Multiplexed and scalable super-resolution imaging of three-dimensional protein localization in size-adjustable tissues." *Nature Biotechnology* **34**, 973-981. (Extends idea of expansion microscopy)

C) Application Papers
   Apply a technique towards answering a broader question, such as which neurons are involved in memory circuits. Entirely chosen by students. Not assigned.
   Ex: Liu et al. 2012. Optogenetic stimulation of a hippocampal engram activates fear memory recall. *Nature* **484**, 381-385

The readings above are representative examples only. A complete list of course readings will be posted separately.

In Part 2, 2-3 classes will be debates on the societal implications of the methods discussed, such as the use of brain scans as legal evidence. All debate topics will be chosen by the students. For the first 45 mins of a debate class, teams of 2-3 students will formally present arguments for opposing sides of an issue, respond to questions, and refute the opposing team's arguments. The formal debate will deliberately present more extreme viewpoints. Afterwards, the debaters will facilitate a round-table discussion on the topic, in which the class will try to decide on a happy medium between the two sides of the debate.

Course Schedule and Administration

Week	Tuesday	Thursday
1 (Jan 4)		Introduction
2 (Jan 9/11)	Introduction	Introduction
3 (Jan 16/18)	Cre-lox methods	Brainbow
4 (Jan 23/25)	DREADDS	Calcium imaging
5 (Jan 30/Feb 1)	CLARITY	Expansion Microscopy
6 (Feb 6/8)	Viral Vectors	Topic of Choice
7 (Feb 13/15)	Optogenetics	Optogenetics
8 (Feb 20/22)	**Reading Break**	

9 (Feb 27/Mar 1)	MRI (structural)	MRI (diffusion)
10 (Mar 6/8)	fMRI	fMRI
11 (Mar 13/15)	EEG	MEG
12 (Mar 20/22)	Neuroethics/debate prep	Topic of choice
13 (Mar 27/29)	Debate 1	Debate 2
14 (Apr 3/5)	Topic of choice	Final synthesis

The course introduction (first 3 classes) will set the tone for all the modules to come, and will include a mixture of course administration (choosing presentation topics, creating a community agreement etc.) and foundational neuroscience content to ensure that all students in the class are on the same page.

All course-related communication between registered students and the coordinator, (including updates to this syllabus), will take place via the group-management platform Slack (to be confirmed in the first week of class). Slack is free to use, but will require an email address to sign up. Students are also able to contact the coordinator at sdsneuromethods@gmail.com, and check the course site blogs.ubc.ca/iscineuromethods for updates.

Assignments and Mark Breakdown

Students will be graded on 5 different components as follows:
Overview presentation (I) – 20%
Reading presentation & discussion facilitation x2 (I/P) – 30%
In-class debate & discussion (P/G) – 20%
Final project (I) – 25%
Participation (I) – 5%

I = individual, P = pairs, G = groups of 3

All components will be peer-graded using rubrics designed with the help of the Faculty Sponsor and ultimately agreed-upon by the class. For the final project, the Faculty Sponsor will have the opportunity to review the projects and grades, and assign new grades if he/she feels that the peer-given ones do not accurately capture the quality of work done.

Please see the "Course Structure" section for information on the overview presentation, discussion facilitation, and debate.

With the final project, students will have the chance to synthesize their knowledge and explore one of the central challenges in neuroscience research addressed by the course in more depth in a ~2000 word paper. For example, a student could focus their project on how to image neurons deep within the brain. In their paper, the student would compare and contrast any relevant methods presented in class, extend the discussion by introducing a technique not presented in class, and present recommendations for future research and applications.

Participation grades will primarily be based on a combination of grading quality evaluations (see the following section). Participation in student-facilitated discussions will be included as a component of the relevant assignment grades.

The Peer-Grading System

All graded work (presentations, discussions, papers, etc.) will be evaluated by other students in the course. To ensure fair and consistent grading, students will be using detailed rubrics to evaluate each assignment. The class will have input on the criteria included in the rubrics (which will be finalized within the first week of classes) and will have opportunities to practice evaluating sample assignments. Each assignment will be graded by a minimum of 4 other students, and the median of these marks will be taken to determine the presenter/writer's final mark. In this way, final marks cannot be drastically altered by a single evaluation.

Students are expected to evaluate all presentations, discussions, and debates that they are present for, and 4 final papers. Graders will need to submit their evaluations to the course coordinator via Slack within 48 hours (presentation/discussions/debate) or 1 week (paper) following the assignment deadline. Grades and comments will then be tabulated by the coordinator, and returned to individual student presenters/writers within 1 week following grade submission.

As giving effective feedback to peers is one of the practical learning objectives of this course, students will also evaluate the quality of comments they receive from their graders. These scores will count towards participation marks.

The class will have opportunities to give feedback on the grading process periodically throughout the term to ensure that it runs fairly and smoothly. If you have any uncertainty about the grading process or believe you have received a mark that is not justified, please contact the course coordinator. Any grading issues will ultimately be resolved by the faculty sponsor, who retains the right to review and reassess all grades in the event of major discrepancies.

Attendance and Incomplete/Late Policies

This is a highly interactive course – more so than most courses at UBC! – and discussion depends on engaged student participation. Attendance at all classes is therefore required as a baseline expectation of all students. If you cannot attend a class for a valid reason, please notify the course coordinator as far in advance as possible in order to allow for any necessary rescheduling. In case of an emergency, please contact the course coordinator as soon as you can following the class to explain your situation and discuss alternative options (in the case of an incomplete assignment).

Any incomplete assignments that are not discussed with the course coordinator and/or the faculty sponsor will result in a mark of "0" for that assignment. Additional penalties for

incomplete/late assignments and/or poor attendance will be decided upon by the class at the beginning of term. All final decisions on such policies and their application rest with the faculty sponsor, particularly in unusual circumstances.

The Student-Directed Seminar Program

This course is one of the student-directed seminars being offered at UBC in 2017-2018, and the following section of the syllabus is common to all seminars.

What is the Student Directed Seminars (SDS) program?
The SDS program is intended to provide senior undergraduate students with opportunities to learn in small, collaborative, peer learning classes. It is also the Program's goal to ensure participants, as members of a self- directed group, have a high degree of control over their own learning experience. This program is unique to UBC and is modeled on an established student-directed seminar program at the University of California at Berkeley. More program details are available at: http://students.ubc.ca/success/student-directed-seminars

How are seminars selected?
To coordinate a seminar, a student in their third or fourth year of undergraduate study, proposes a course not currently offered at UBC. Proposals are reviewed by a multidisciplinary Advisory Committee made up of Faculty, Staff and Student members. Proposals are evaluated for academic rigour, suitability of the Student Coordinator, and the quality of the learning experience being proposed. We are looking for innovative, academically rich learning opportunities that create a strong peer-based learning experience for participants. Coordinators are also required to have a Faculty Sponsor for their seminar who provides support and guidance during the application and during the implementation of the seminar.
Following approval of their proposal, Student Coordinators undertake more detailed planning of their seminar. Coordinators receive extensive training before the seminar begins focusing on facilitation, lesson planning, designing rubrics, facilitating peer-grading, and creating an inclusive classroom environment.

How many can I take and what credit will I get?
Seminars are limited to upper-year students and it is up to individual students to determine how seminars will count towards their degree through conversations with an academic advisor. **Students are only permitted to register and receive credit for one seminar as a participant and one seminar as a Student Coordinator.**

What are the roles of the Coordinator and Participants?
The Student Coordinator is not an instructor. The Coordinator's role is that of a facilitator. S/he is responsible for creating the framework for the class and organizes the learning resources (guest lectures, reading materials, films etc.). The Student Coordinator also sets the parameters of course content, structure, and grading procedures, in conjunction with a Faculty Sponsor. The Coordinator will take on a regular role as facilitator and administrator of the class to keep things moving, but is not an expert in the subject matter and is coming to the class to learn with, and from, you.

Participants also have an important role in refining the course content and direction during the first classes of the term and play an even bigger role as a facilitator during the class. All students are responsible to one another for ensuring that the learning experience has a quality and richness that benefits everyone.

What is the role of the Faculty Sponsor?

Faculty Sponsors guide the creation of the seminar proposal, refining reading lists and grading schemes, may grade portions of the academic work, and ultimately is responsible for the grades that are submitted for this course. They are also a resource for any student needing support or guidance during the seminar and support the Coordinator should any challenges arise.

What about Academic Misconduct?

Cheating, plagiarism, and other forms of academic misconduct are very serious concerns of the University, and the Student Directed Seminars program takes accusations of these behaviors very seriously.

In all cases of suspected academic misconduct, the Faculty Sponsor for the course will document evidence of the allegations and forward this evidence to the Chair of the SDS program. The Chair will then process and forward the case to the Faculty offering the SDS course. The parties involved will be required to participate in the University's process for academic integrity as dictated by the guidelines of the University.

Strong evidence of cheating may result in a zero credit for the work in question. According to the University Act (section 61), the President of UBC has the right to impose harsher penalties including (but not limited to) a failing grade for the course, suspension from the University, cancellation of scholarships, or a notation added to a student's transcript.

More information on the University's Policy on Academic Misconduct is available at: http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959.

Have questions?

Please contact Program Staff at student.seminars@ubc.ca with any questions, concerns, or ideas you might have.