

KCNI Summer Academy 2023 Project Week



When: July 10-14, 2023

Intended Audience: Graduate Students, Post-Graduate Research and Clinical Fellows, as well as Early-Career Scientists with interest in learning more about Neuroinformatics

Where: **In-person** at the Krembil Centre for Neuroinformatics, 12th Floor, 250 College Street, Toronto, Canada

Cost: Minimal (\$50), only 30 spots available

Click here to apply!

Application Deadline has been extended to June 9, 2023, 11:59PM EST!

Those selected to participate will be contacted in mid-June to register.

Overview

The Krembil Centre for Neuroinformatics is excited to offer a five-day intensive project-based learning week where trainees will learn hands-on techniques for integrating multi-scale neuroscience data. This course is designed to introduce participants to the concepts and methods behind psychiatric neuroinformatics - encompassing genetics, brain structure and function, and cognition.

In addition, participants will uncover the links between modalities of human genomics, neuronal electrophysiology, structural and functional neuroimaging, and observed behaviour that KCNI scientists are integrating through a series of virtual modules and a group-based project using real-world data types to study mental illness.

This unique learning opportunity will prepare participants to handle and analyze multiple data types in hopes that their own research may benefit from collaborative, multi-modal approaches. Critically, participants will also learn about best practices for data management and quality control in the context of integrative analysis.

Registration now open [Click here to apply!](#)

Application Deadline June 2, 2023

Those selected to participate will be contacted in mid-June to register.

Course Requirements and Prerequisites

Applications from senior undergraduate students, graduate students, post-graduate research and clinical fellows, and early-career scientists will be considered. Researchers from diverse backgrounds (e.g. medicine, computer science, biology, psychology, engineering etc.) are encouraged to apply. To ensure that all attendees can fully follow and benefit from the practical assignments, fundamental and demonstrable experience in R and Python is a minimum requirement.

Delivery Method

Students will be provided with a collection of virtual didactic teaching (lectures) and hands-on tutorial components to engage critical thinking and develop practical skills in crucial selected areas. Lessons will be led by members and affiliates of the KCNI team, including faculty at the University of Toronto's Department of Psychiatry. Successful applications to Project Week will be mentored (in-person or hybrid) by KCNI Scientists as they complete one-week intensive group projects matched to their interests. These projects will allow participants to build mastery in selected integrative research methods.

All project week participants will take part in each full day of training. Students will have the opportunity for project-specific discussions, collaboration, and guidance outside of structured time.

Students will present their group project to KCNI Scientists at the conclusion of Project Week. Project week will occur in person at CAMH KCNI and be supplemented by multiple networking, collaboration, and socializing opportunities.

The 2023 Project Week Schedule

The schedule can also be accessed via these links: [HTML](#), [ICS](#)

Today						<	>	July 10–14, 2023						▼
10 Mon		11 Tue		12 Wed		13 Thu		14 Fri						
8 AM														
☕ Check-in and Breakfast		☕ Breakfast Available		☕ Breakfast Available		☕ Breakfast Available		☕ Breakfast Available						
KCNI Academy - Welcome and Orientation KCNI School		Morning Hacking KCNI School		Morning Hacking		Morning Hacking KCNI School		Morning Hacking						
☕ Morning Coffee Break														
🕒 Morning Hack Time		🍷 KCNI Academy Lunch and Learn - Fireside Chat with CAMH Clinicians KCNI School				🍷 KCNI Academy Lunch and Learn - All things apps KCNI School								
🍷 Lunch Break				🍷 Lunch Break				🍷 Lunch Break						
🕒 Afternoon Free Hacking Time		🕒 Afternoon Free Hacking Time		🕒 Afternoon Free Hacking Time		🕒 Afternoon Free Hacking Time		🕒 Afternoon Free Hacking Time						
☕ Coffee and Cookies		☕ Coffee and Cookies		☕ Coffee and Cookies		☕ Coffee and Cookies		☕ Coffee and Cookies						
More Free Hacking		More Free Hacking		More Free Hacking		More Free Hacking		More Free Hacking		📋 Final Wrap Up Presentations and				
Project Presentations														
5 PM														

This year's projects

This year's students will be split into groups who will each focus on one of the projects given below, with guidance from KCNI trainees and staff



Project 1 - Single Cell Transcriptomics

Integrative analysis of human single-nucleus gene expression datasets: How are neocortical cell types defined by gene expression and how do cells' gene expression patterns change in Alzheimer's disease?

Main idea: perform integrative analysis human neocortical cell types according to transcriptomics.

Key questions / objectives:

- What genes / features distinguish cell types in the human neocortex?
- How many neocortical cell types can we reliably define on the basis of gene expression?
- How are cell types different between people? like because of differences in sex or Alzheimer's disease status?

What (dataset) resources are available to help answer this question? Allen Institute for Brain Sciences Cell Types database <https://celltypes.brain-map.org/>

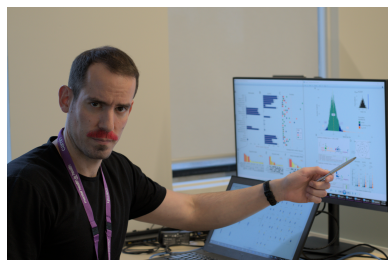
Programming Languages: R/Studio, (Seurat)

Link to GitHub: https://github.com/sonnyc247/KCNISS_2022_Week2



Lead Scientist/Lab: Shreejoy Tripathy

Teaching Assistants: Mel Davie &
Derek Howard



Lead Scientist: Daniel Felsky

Teaching Assistants:

- Earvin Tio
- Rajith Wickramatunga
- Mohamed Abdelhack
- Emily Wiljer



Project 3: Transdisciplinary Mental Health Modeling with Machine Learning

From domain-specific data to transdisciplinary models: an exercise in whole-person modeling from feature engineering to model explanations.

What's this project about?

Building a transdisciplinary machine learning model to predict risk for mental illness in a large simulated human population dataset. This will involve exposure to genetic, neuroimaging, and sociodemographic data types and their integration.

Key Questions/Objectives

- **Objective 1:** How to approach a multi-disciplinary analysis
 - Steps to approaching a new dataset: how to handle data formats, variable types, missing data, transformations?
- **Objective 2:** Feature engineering from different data modalities
 - How do we go from raw data (i.e. genotype, brain scans) to individual level features?
- **Objective 3:** develop a transdisciplinary machine learning model
 - How do we combine multiple data types into one predictive model?
 - Can we analyze feature importance to understand relative contributions from different domains?

Programming Languages

- Bash, Python, R

Link to code: [Overview \(deepnote.com\)](https://deepnote.com)

Project 4 - Whole-brain modelling of noninvasive neurostimulation therapeutics and neuroimaging connectomics

What's this project about?

Main idea: use neuroimaging-based computational models of TMS brain stimulation to investigate the micro-physiological and macro-network effects of TMS therapies used in psychiatry and neurology

Key questions:



Lead Scientist: John Griffiths

Teaching Assistants

- Davide Momi
- Shreyas Harita
- Zheng Wang
- Sorenza Bastiaens
- Taha Morshedzadeh
- Kevin Kadak

- What do the electromagnetic stimulation patterns look like in 3D volume space and 2D surface space for different TMS target regions and targeting methodologies (eg 10-20 coords vs beam-F3 vs neuronavigated)?
- What do the associated whole-brain network stimulation patterns look like, as calculated using anatomical and/or functional connectivity information from MRI scans?
- What is the spatiotemporal pattern of stimulated activity propagation across the brain as measured with source-localized EEG?
- How do we use connectome-based neural mass modelling to unpack the structure of this activity propagation?
- How do neurophysiological properties such as excitability and level of inhibition affect this propagation, and differ across individuals and following clinical interventions?
- How can we incorporate theories and models of neural plasticity into the picture here?

Programming Languages: Python, PyTorch

Link to GitHub:

The project will be based on the code and associated (open-access) scientific papers available at these two github repositories

<https://github.com/GriffithsLab/PyTepFit>

https://github.com/GriffithsLab/HaritaEtAl2022_tms-efield-fc

Reference reading:

Momi et al. ELife 2023

Harita et al. Front Psych 2022

Griffiths et al. 2022

Griffiths et al. 2020