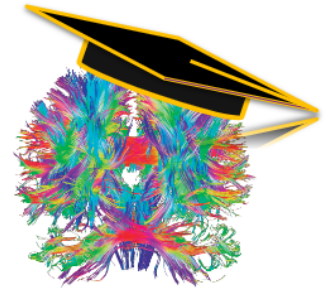# KCNI School 2022 Project Week

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.

Schedule for the Week

	4 Mon	5 Tue	6 Wed	7 Thu	8 Fri
8 AM					
9 AM	🎓 KCNI School Set-up KCNI - 250 College Street - KCNI School		🎓 KCNI School - Neur Hybrid - zoom link to follow KCNI School		
10 AM	🎓 KCNI School Day 1 KCNI - 250 College Street - KCNI School	🎓 KCNI School Second Project KCNI School	🎓 KCNI School Morning Group Work KCNI School	🎓 KCNI School Morning Group Work KCNI School	🎓 KCNI School Morning Group Work KCNI School
11 AM 12 PM	🎓 KCNI Summer School Computing Fundaments KCNI School	🎓 KCNI School Ethics and Fairness Workshop KCNI School		🎓 KCNI School Clinical Integration Fireside Chat KCNI School	🎓 KCNI Summer School Digital Health Mini workshop KCNI School
1 PM 2 PM	🎓 KCNI School Afternoon Group KCNI School	🎓 KCNI School Afternoon Group KCNI School	🎓 KCNI School Afternoon Group KCNI School	🎓 KCNI School Afternoon Group KCNI School	🎓 KCNI School Afternoon Group KCNI School
3 PM					🎓 KCNI School Final Project Presentations KCNI School
4 PM	🎓 KCNI School First Project Pitches				
5 PM					

Project Ideas Themes

Project 1 - Genomics

Using Tractor for ancestry-specific GWAS in admixed populations.

Tutorial link: https://github.com/milicmil /KCNI_summer_school_tractor_gwas

How do we analyze admixed individuals in the context of genome-wide association and how do we explore/visualize the results?

Genomics TAs: Emily Wiljer, Mu Yang, Earvin Tio

Project 2 - Single Cell Transcriptomics

Integrative analysis of mouse and human single-cell gene expression data. What are conserved cell types in the brain and what are their characteristics?

What's this project about?

Main idea: perform integrative analysis of mouse and human (and possibly other species, including macaques and marmosets) neocortical cell types according to transcriptomics and possibly intrinsic electrophysiology. These analyses will directly feed into cell and circuit models of mouse and human circuits, led by Etay's group.

Key questions:

1. Can we identify orthologous cell types between species?
2. What genes / features distinguish cell types?
    a. Are there aspects of these features that seem relevant to computational processing of cells and circuits?
    b. What characteristics of these features can be modelled in the context of cell and circuit models?

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

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

Transcriptomics TAs: Sonny Chen, Mel Davie

Project 3 - Simulating Ketamine Effects on Cortical Neuronal Networks and EEG

The project will simulate spiking activity in simplified neuronal networks in health, depression, and depression + ketamine conditions. The simulated activity will reproduce baseline and response firing rates, as well as EEG in a network of simplified neurons belonging to key types in the cortex. The project will model the effect of ketamine on specific neuronal mechanisms and neuron types in the network.

Pre-requisite learning and installation guide found on github: https://github.com/FrankMazza/Microcircuit-Modelling-2022.git

TAs: Alex Guet-McCreight & Frank Mazza

Project 4 - fMRI based Whole Brain Modeling

Using computational network models of neuroimaging data to identify physiological mechanisms and signatures of mental illness

The project will apply connectome-based whole-brain modelling to study meso- and network-level mechanisms underlying brain connectivity patterns in functional MRI data. The specific focus is on brain signatures of sleep deprivation, which has well-understood relationships to a wide variety of clinical conditions across both psychiatry (e.g. depression, schizophrenia) and neurology (e.g. alzheimers, parkinsons). This research area is prosecuted jointly by KCNI groups - whole-brain modelling (Griffiths lab) and cognitive network modelling (Diaconescu lab), and this project is a collaboration between these.

Whole Brain TAs : Shreyas Harita, Davide Momi, Sorenza Bastiaens

CogNeMo TAs: Zheng Wang, Milad Soltanzadeh, Daniel Wurgaft

Github links:

https://github.com/GriffithsLab/kcnischool2022-projectweek (info, materials, kanban scrum project management)

(see also https://github.com/krembilneuroinformatics/openneuro_preproc)

Pre-requiste Learning Materials

Get Pre-requisite learning material from the KCNI School Virtual Learning Series