Comprehensive Research Experience for Medical Students (CREMS)
2022 Supervisor and Project Information Form

Please complete and return via email ONLY to crems.programs@utoronto.ca by February 18, 2022.

Supervisor Information

NOTE: CREMS will not support pre-determined pairings of students and supervisors. Supervisors must agree to open their projects to all students and interview all that are interested.

Name: Daniel Felsky
Email: Daniel.felsky@camh.ca

Department: Krembil Centre for Neuroinformatics

Hospital/Research Institution: Centre for Addiction and Mental Health

SGS Department(s) (if applicable):
Institute of Medical Science

ORCID ID (see https://orcid.org/ - if you do not have an ORCID ID we encourage you to sign up for one):
https://orcid.org/0000-0003-1831-9848

Location of Work:
Hybrid: CAMH, 250 College St, Toronto, ON. 12th floor [AND/OR] remote

Field of Research (up to 4 keywords):
Mental Health, Genetics, Machine Learning, Biostatistics

Student contact time (number of hours per week YOU are available to the student for any concerns or to review progress):
I meet with all trainees one-on-one for at least 30min per week, and am available all day (when not in meetings) on our Centre’s Slack social platform and by email.
Project Information

NOTE: If this project is selected, this information will be posted on CREMS website for interested student applicants to view research opportunities.

PROJECT TITLE:
Whole Person Modelling of Cognitive Resilience in Late Life

PROJECT DESCRIPTION:
Including background, aim(s), methods and significance of the project. Maximum 300 words.
The complex combinations of socio-demographic, geographic, lifestyle, and experiential factors that determine resilience to late-life cognitive decline are not well understood. Through community-based studies led by scientists at Rush University Medical Centre (Chicago, IL), we have compiled high-dimensional biopsychosocial data types from over 3,500 elderly individuals, with nearly half of them having donated their brain for postmortem neuropathological examination.

Our primary study aim is to identify the top contributors to cognitive resilience in late life among a spectrum of biopsychosocial (“whole person”) measures.

The successful candidate will be responsible for describing these data and developing models of longitudinal cognitive decline using statistical software (e.g. R, Python). The approach has three main steps: 1) repeated measures modelling of cognitive trajectories to identify principal study outcomes, 2) statistical modeling of these cognitive trajectories using multivariate methods, and 3) model interpretation.

Linear mixed models will be used to calculate individual-level trajectories of cognitive decline. These slopes will be compared to neuropathological burden measured postmortem to determine resilience (little cognitive decline despite severe brain pathology) vs. susceptibility (substantial cognitive decline despite lack of brain pathology). Machine learning models, such as LASSO regression and random forest, will be used to model the effects of demographic, sensory, genetic (APOE e4 risk factor), motor, and social factors on this resilience vs. susceptible metric. Model interpretation will be performed using “explainable AI” techniques, such as SHAP, to identify the constellation of predictive factors which are most associated with our key outcomes, and which of those factors may moderate the effects of others.

This work has the potential to guide future research toward the most important factors determining resilience to late-life cognitive decline.

Is this project remote-capable (in case of new restrictions) or have an alternative remote option?
☒ Yes, remote capable ☐ No
☐ Yes, alternate remote option. Please specify (100 words max): Click or tap here to enter text.
If human subjects are involved, have the appropriate Research Ethics Board approvals been obtained?
☒ Yes ☐ No ☐ Not Applicable

If yes, please list the application submission date:

Do you expect this work will be published?
☒ Yes ☐ No ☐ Uncertain / Other
Research Environment and Student Roles and Responsibilities

Please be specific as possible. Please describe the research environment, including availability of required facilities/equipment/expertise, supervisor’s experience and mentorship plans. Please clearly outline the student role(s) and responsibilities related to the project, potential educational value, and indicate who will serve as the student’s direct report for daily oversight (PI, PHD student, technician, etc.). Maximum 300 words.

CAMH is Canada’s largest mental health teaching hospital. Within CAMH, the Krembil Centre for Neuroinformatics (KCNI) sits at the cutting edge of neuroinformatics research. Ample dedicated desk space has been demarcated for trainees and is currently bookable online to allow for contact tracing, if needed. Funding for basic research tools, including laptop computers, large monitors, and other amenities has been provided. Several centralized resources are available to trainees as part of the core KCNI infrastructure, including our specialized computing cluster (SCC), which is CAMH’s dedicated high performance computing environment - accessible remotely - and used in tandem with the U of T/Compute Canada SciNet Niagara cluster.

Dr. Felsky’s computational research group at KCNI, called the “Whole Person and Population Modeling”, specializes in multivariate models of psychiatric illness with a foundation in genetics. The lab currently includes 4 MSc-, 2 PhD-, and 4 postdoctoral-level trainees, as well as one research analyst. The successful applicant will interact with the entire group as part of weekly meetings, presentations, an annual KCNI summer school, and ongoing virtual engagement through our “always-available” KCNI Slack social platform. The successful student will receive direct primary guidance on this project from Dr. Felsky and a postdoctoral fellow with a strong background in statistical and computational mentorship and expertise in integrative machine learning modelling in healthcare.

The student will have experience with statistical computing (i.e. R or Python), as well as (at minimum) foundational exposure to regression modeling, cross-validation, and data visualization. Experience with modelling repeated measures data or machine learning methods will be a strong asset. Experience with population-level cohort datasets or epidemiological work in psychiatry or neurology will also be an asset.