

Innovations Lab: Interdisciplinary Approaches to Biomedical Data Science Challenges

Goal

The goal of the Innovations Lab is to foster the formation of new interdisciplinary collaborations that will generate creative strategies for addressing challenges associated with the visualization, modeling, and analysis of biomedical data. Such challenges arise from complex data structures like networks and images, complexities arising out of missingness and sparsity, the need for integration from multiple sources, interaction effects, etc. This Innovations Lab is intended to bring together expertise from the mathematical, statistical, and biomedical fields, to address interdisciplinary topics in biomedical data science central to precision medicine (In this document, the term “biomedical” will be used in the broadest sense to include biological, biomedical, behavioral, social, environmental, and clinical studies that relate to understanding health and disease). It is anticipated that collaborations formed during the Innovations Lab will result in proposals for 1-year awards to further develop, refine, and test hypotheses.

Description

The Innovations Lab will stimulate communication between mathematicians, statisticians, and biomedical researchers on developing models, methods, and approaches for overcoming challenging problems in precision medicine, an important application area at the intersection of the biomedical and data sciences. Precision medicine is an emerging approach for disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle for each person. Achieving the promise of precision medicine will require integration of different data formats, including structured and unstructured data, observational and experimental data, from across a heterogeneous populations at multiple scales, ranging from people to cellular organelles, and the development of computational and analytical methods to enable high-confidence predictions for individuals. Since the interdisciplinary problems at the intersection of Big Data and biomedical sciences are numerous, the Innovations Lab to be held in Summer 2015 is a pilot which, if successful, could lead to others for different audiences and topics.

[Network analysis](#), [causal analysis](#), and [machine learning](#) are among the important tools for modeling, simulation, and [visualization](#) of large-scale, and multi-dimensional, integrated data. The data on which these methods will be used are complex due to what is not present ([missing data](#)), and also what is implicit, such as an underlying network structure of dependencies. Collaborations between biomedical and quantitative scientists (e.g. mathematicians, statisticians, computer scientists, physicists, and engineers) with relevant expertise could lead to better approaches to implementation and interpretation.

At the Innovations Lab, interdisciplinary teams will work together to innovate and develop pilot approaches for tackling selected problems. Potential biomedical topics for the Innovations Lab range across scales, from single-cell experiments to complex subsets of populations. Topics may lead to new insights and lay the groundwork for future advances in precision medicine. Examples could include inferring cell-circuitry networks, predicting the effect of biomedical changes on health outcomes in subpopulations of humans, or [natural language processing](#) for electronic health records.

Publicly available multi-scale, multi-modality data that may be used include, but are not limited to, LINCS data, dbGaP data, Human Connectome Project data, NDAR, ADNI, FITBIR, and Trauma-TBI.