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Department of Medicine
Channing Division of Network Medicine

Channing Methods Seminar

April 23 (Tuesday), 2024, 11AM (ET)

MCP 5th-floor conference room & Zoom:

<https://us02web.zoom.us/j/579497999?pwd=cHNIWHMzWUJFUUVJTG1EeVJmY05aQT09>

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Fabian J. Theis

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Generative AI for modeling cellular state

Abstract: Advances in single cell genomics nowadays allow the large scale construction of organ atlases. These can be used to study perturbations such as signaling, drugs or diseases, with large-scale access to state changes on the multi-omic and spatial level. This provides an ideal application area for machine learning methods to understand cellular response. With generative AI revolutionizing many fields of science by allowing researchers to explore uncharted territories, generate novel hypotheses, and simulate complex phenomena, we ask how it has been enabling modeling single cell variation, potentially towards a single cell foundation model.

After reviewing deep generative representation learning approaches to identify the gene expression manifold, I will shortly outline some applications on cell atlas building. Then I will discuss interpretable modeling of perturbations on this manifold, in particular effect of drug responses as well as multiscale readouts such as disease state across patients, and how to learn organism-wide cell type predictors. I will finish with presenting Nicheformer, a foundation model for single-cell and spatial omics, going beyond disassociated analysis to capture and predict local tissue context at single-cell level.

Bio: Fabian Theis is the Director of Helmholtz Munich Computational Health Center and Scientific Director of HelmholtzAI, which was launched in 2019. He is a Full Professor at the Technical University of Munich, holding the chair 'Mathematical Modelling of Biological Systems,' Associate Faculty at the Wellcome Trust Sanger Institute, Hinxton, Scientific Director of Biomedical AI at Helmholtz Pioneer Campus HPC. Fabian Theis is a pioneer in biomedical artificial intelligence and machine learning, particularly in single-cell genomics, with a focus on trajectory learning and perturbation modeling. By developing and adapting inference methods to integrate information across scales, he contributes to answering complex biological and medical questions such as stem-cell decision-making and the impact of cellular heterogeneity in systems medicine. His lab implements analysis software with a large user-base, which in parts becomes de facto standards in their application areas, paving the way for 'the medicine of the future'. Fabian Theis was recently awarded with an ERC advanced grant for his project 'DeepCell' in 2022, and received the Leibniz Prize in 2023 – the most prestigious research award in Germany.

Hosted by Yang-Yu Liu