

## **Bayesian machine learning models for understanding microbiome dynamics**

The human microbiome is highly dynamic on multiple timescales, changing dramatically during development of the gut in childhood, with diet, or due to medical interventions. I will present several Bayesian machine learning methods that we have developed for gaining insight into microbiome dynamics. The first, MC-TIMME (Microbial Counts Trajectories Infinite Mixture Model Engine), is a non-parametric Bayesian model for clustering microbiome time-series data that we have applied to gain insights into the temporal response of human and animal microbiota to antibiotics, infectious, and dietary perturbations. The second, MDSINE (Microbial Dynamical Systems INference Engine), is a method for efficiently inferring dynamical systems models from microbiome time-series data and predicting temporal behaviors of the microbiota, which we have applied to developing bacteriotherapies for *C. difficile* infection and inflammatory bowel disease. The third, Microbiome Interpretable Temporal Rule Engine (MITRE), is a method for predicting host status from microbiome time-series data, which achieves high accuracy while maintaining interpretability by learning predictive rules over automatically inferred time-periods and phylogenetically related microbes.

Dr. Gerber is a computer scientist, microbiologist and physician board certified in Clinical Pathology. He is an Assistant Professor of Pathology at Harvard Medical School and member of the Harvard-MIT Health Sciences and Technology faculty, Chief of the Division of Computational Pathology at the Brigham and Women's Hospital (BWH), and Co-Director of the Massachusetts Host-Microbiome Center (MHMC) at BWH. His research lab builds novel computational models and experimental systems to understand the role of the microbiota in human diseases and applies these findings to develop new diagnostic tests and therapeutic interventions to improve patient care. His work has been funded by DARPA, NIH, the state of Massachusetts, private foundations, and corporate sponsorship.

Dr. Gerber's training includes a Fellowship in Infectious Disease Pathology and Molecular Microbiology at BWH, Residency in Clinical Pathology at BWH, MD from Harvard Medical School, Masters' and PhD in Computer Science from MIT (supervised by David Gifford, Tommi Jaakkola and Rick Young), and Masters' in Infectious Diseases and BA in Pure Mathematics from UC Berkeley. Prior to returning to graduate school, he founded several companies focused on developing and applying 3D graphics technologies to create feature and IMAX® films.