Analysis Colloquium – 11/02/2018

**Title:** Dynamics, Topology, and Learning

**Abstract:** There are numerous examples in the literature in which topological data analysis (TDA) is combined with statistical or machine learning approaches to gain insights into dynamic data. In this talk we will first consider two examples as case studies that highlight important and general concepts concerning the applicability of TDA to dynamic data, and the use of TDA in concert with machine learning. In particular, we first look at the problem of tracking moving objects in wide-area images, and then at a study of neuronal activity in mouse hippocampus. Both examples will highlight issues related to the stability of generating and vectorizing persistence diagrams. These examples will also highlight the importance of small-persistence features, which we discuss as a general phenomenon supported by examples from diverse data types. In contrast to the aforementioned studies, and most published work in this domain, we discuss an alternative paradigm for analyzing dynamic data—especially data coming from complex, spatiotemporal systems—using TDA and learning methods. In this setting, we regard TDA as a dimensionality reduction that enhances a learner’s capacity to train models on sparse data. We end with a call to tackle the important and difficult goal to develop statistical models that are predictive of hurricane rapid intensification using geosynchronous satellite imagery.