Data Science Seminar

Hosted by Department of Mathematical Sciences

- Date: Tuesday, November 9, 2021
- Time: 12:00pm – 1:00pm
- Room: Zoom
- Speaker: Dr. Megan Johnson (Internal)
- Title: The Interconnectivity Vector and the Betti Sequence: Finite-Dimensional Vector Representations of Persistent Homology

Abstract

Topological Data Analysis (TDA), a relatively new field of data analysis, has proved very useful in a variety of applications. The main persistence tool from TDA is persistent homology in which data structure is examined at many scales. Representations of persistent homology include persistence barcodes and persistence diagrams, both of which are difficult to reconcile with traditional machine learning algorithms as they are sets of intervals or multisets. We propose a new finite-dimensional vector, called the interconnectivity vector, representation of a persistence diagram. This new representation is constructed to demonstrate the connections between the homological features of a data set. This initial definition of the interconnectivity vector proves to be unstable, and thus we introduce a stabilized version of the vector based on the Gaussian smoothing seen in the stable persistence bag-of-words vectorization for persistent homology. A second vectorization discussed is the Betti sequence, or Betti curve, derived from the persistence barcode. While the Betti sequence has been used in classification problems in various applications, to our knowledge, the stability of the sequence has never before been discussed. As the Betti sequence proves to be unstable, we propose a novel stabilized Betti sequence. This talk will finish with an application of vectorization methods to the classification of vascular stenoses. Each vector proposed in this research is used to classify blood flow velocity data from 64 patients and we examine the correlation between the vectors and the fractional flow reserve from each patient.

Biography of the speaker: Dr. Johnson is a new Robert Riley Visiting Assistant Professor in the Department of Mathematical Sciences this semester having graduated from the University at Buffalo this summer. Her research focuses on vector representations of persistent homology, their use in machine learning, the design and implementation of computational algorithms for topological data analysis, methods for defeating the Runge and Gibbs phenomena in numerical analysis, and the study of fractal dimensions.