Winter 2017

MAT 180: Analyzing structural molecular biology data using topological methods

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**Course Outline:** Topology has become an essential tool in applied mathematics and in the analysis of bigdata  in molecular biology  and material science.  In this course we will present three different topological approaches to study the structure of DNA and chromosomes. These methodologies can also be used to study other polymers and the structure of big data in general.

Chapter 1: Analysis of DNA structural data using random knotting

* Random knotting: Basic definitions and results
* Monte-Carlo algorithms to generate random knots

  -     Applications of random knotting to the analysis of chromosome conformation

        capture data

Chapter 2: Modeling DNA site-specific recombination using tangles

* Tangles: definitions and classification
* Tangle calculus, theory and computation
* Analysis of site-specific recombination using tangles
* Computer simulations of recombination

Chapter 3: Analysis of Cancer DNA Copy number using persistence homology

* Algebraic topology: simplicial complexes and homology groups
* Analysis of time series using homology groups
* Application of homology to the analysis of copy number data

**Evaluation:** Students will be evaluated based on homework assignments and a research group project.