ISU ALGEBRA SEMINAR

FALL 2016 SCHEDULE

Wednesdays, 11:00 AM-11:50 AM at Williams Hall, room 21
Refreshments will be provided.

November 16, 2016

Speaker: Füsun Akman

Talk title: Spectral Graph Theory in Gene Regulatory Networks: Part II

A **Gene Regulatory Network** (GRN), an example of which is the *lac operon* of *E. coli*, is a collection of genes/chemicals inside a cell that is in charge of some process. By using microarray data, scientists try to figure out which "genes" directly influence each other and represent this by a directed graph (digraph). We'll assume that each gene can be ON or OFF at a given time step, and the overall state of the GRN is updated synchronously and simultaneously. Whether studying the abstract properties of GRN's or reverse-engineering real live GRN's from data, researchers usually do large amounts of simulations and assign random "influences" to genes at first. We show that studying the "phase space" of the GRN, a much larger but simpler digraph, in terms of the **eigenvalues and eigenvectors of its adjacency matrix**, gives us valuable properties and indeed a complete identification of the GRN right away. We also define a notion of **entropy** using the automorphism graph of the phase space, which can be computed by a fast algorithm. Finally, we show that a certain notion of **stability and adaptability**, without which life cannot exist, is tied closely to entropy according to our simulations.

This is a joint work with Devin Akman at UIUC.