

## **Rosemary Braun (Northwestern University)**

[Lecture] Title: Lively Networks

Many systems -- including living cells -- exhibit collective behaviors that emerge from complex networks of many interacting processes. What can the "wiring diagram" of those interactions tell us about the dynamics of the system, and can we deduce the underlying network from the collective dynamics? In this talk, I will discuss what we can learn about the dynamics of interacting systems from the topology of the underlying network of interactions. I will introduce the formalisms of spectral graph theory and network filtration, and illustrate how these approaches can help us model how living systems respond and adapt to perturbations.

[Breakout session] Title: Seeing the forest and the trees: multi-scale approaches for analyzing cancer omics data.

Advances in high-throughput "omic" assays now make it possible to probe the molecular state of a sample in genome-wide detail, providing unprecedented opportunity to investigate disease mechanisms by simultaneously profiling thousands molecular markers per sample. To date, however, most analyses of omic data consider each marker independently and treat regulatory pathways as a "sum of their parts." By neglecting the network of interactions, such approaches can miss crucial multi-gene effects associated with disease. This talk will present some recent techniques to incorporate pathway information into the analysis of high-dimensional omic data. By analyzing data at the systems level, the methods enable us to integrate disparate types of omic data, make inferences about disease mechanisms, and distinguish sets of cumulatively deleterious alterations from those that compensate one-another to preserve the overall function of a pathway. We will show how these analyses can overcome the high variability of omics data to yield results that are more reproducible across studies, and demonstrate how these methods can be used to identify novel therapeutic and diagnostic targets.