CMS/CS/EE 144
Networks: Structure & Economics

Administrivia

1) QUIZ TODAY
2) Rankmaniac is ending tomorrow!
3) Rankmaniac reports due monday
   …really, it's best to finish them as you do the project!
4) HW5 out on today (due in 2 weeks)
   …short and easy. Get it done before pandemaniac!
5) Pandemaniac out next week
   …much less "overhead" than rankmaniac
6) Don't forget to think about your project ideas!

Today

Communities & Clusters:

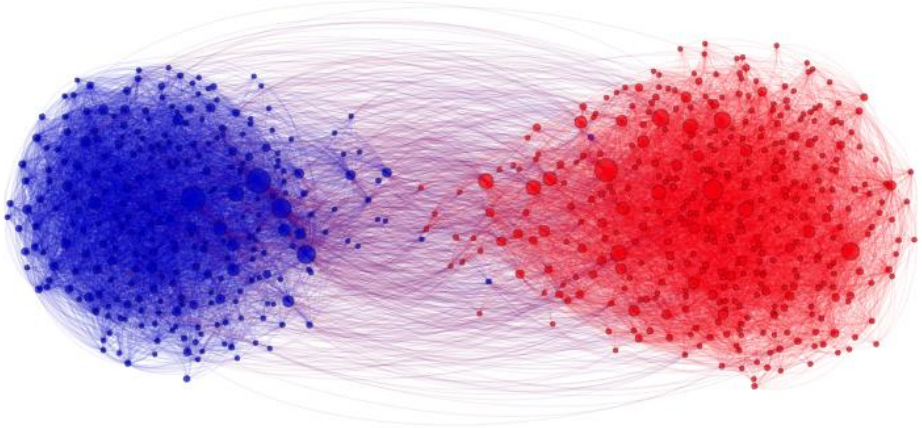
Can you hear the shape of a network?

We've danced around clustering the whole term

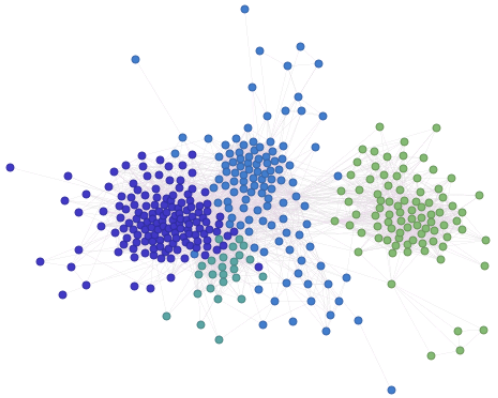
…it's one of our universal properties
…it lets you optimize pagerank computations
…it's crucial for information cascades
…it's been in lots of your blog posts

But, we still haven't given a satisfying definition of a "cluster" !

Political blogs

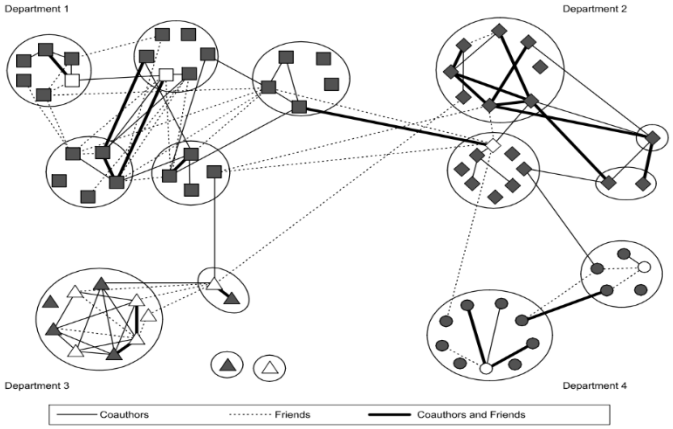


My “ego” network on FB



Company org hierarchy

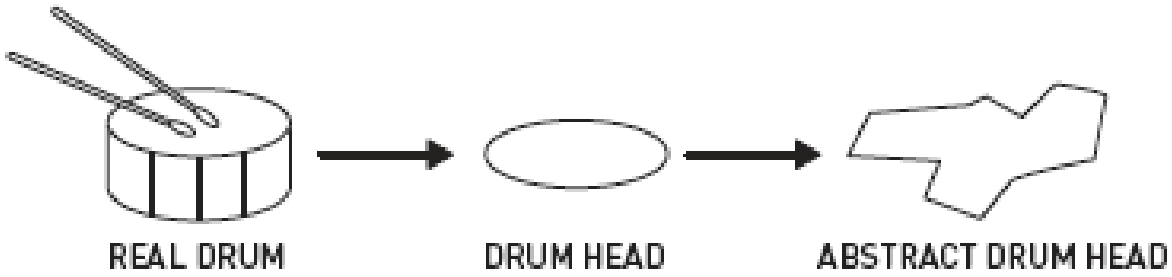
Academic collaborations



What defines a “good” clustering, a.k.a. partitioning of a network?

Can you hear the shape of a drum?

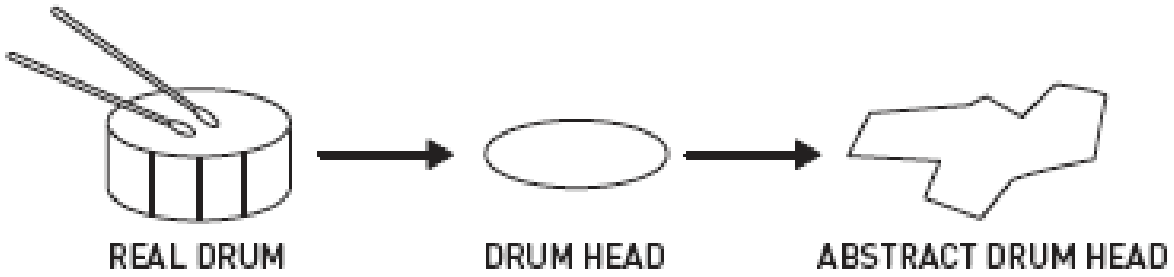
(Do the eigenvalues of the Laplacian uniquely determine the shape?)



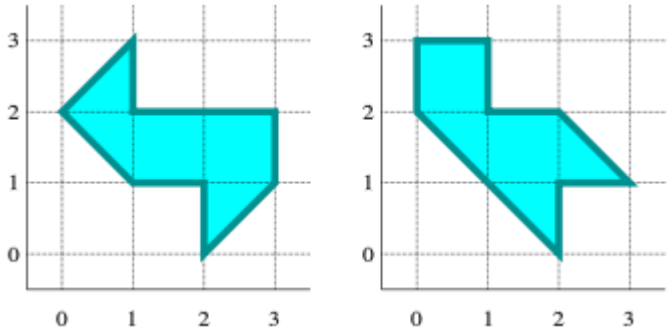
Frequencies of vibration → eigenvalues of the Laplacian!

Can you hear the shape of a drum?

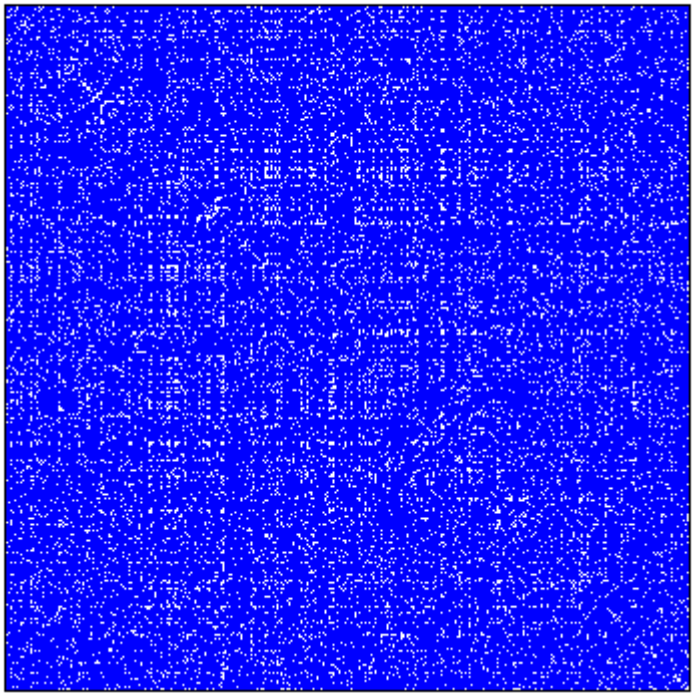
(Do the eigenvalues of the Laplacian uniquely determine the shape?)



No! →

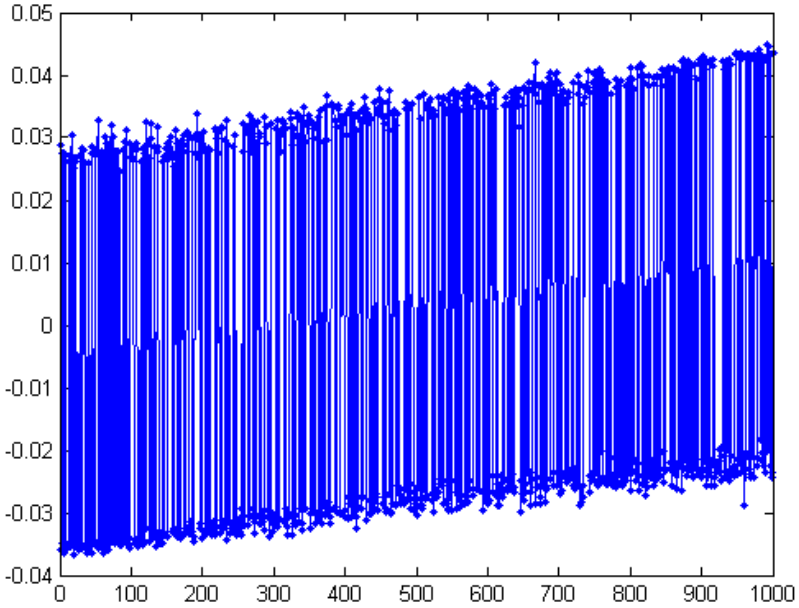


Example:

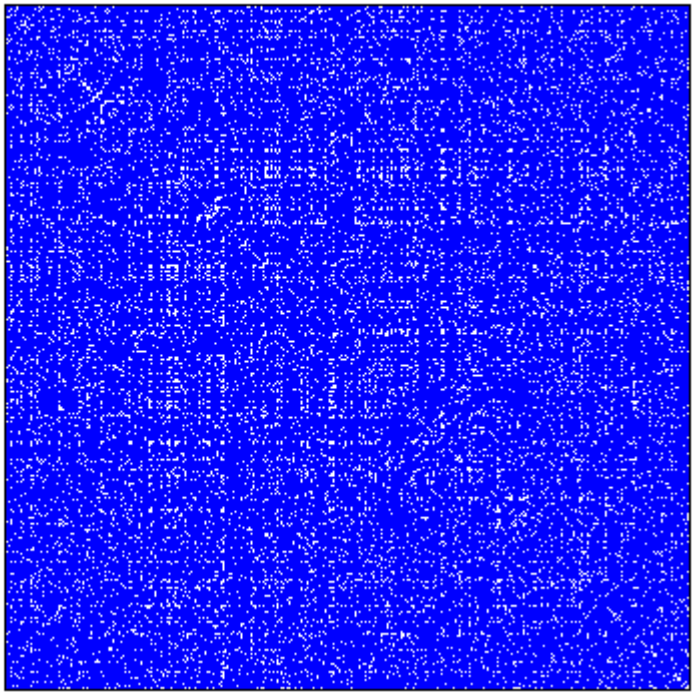


Adjacency matrix

Eigenvalues of Laplacian

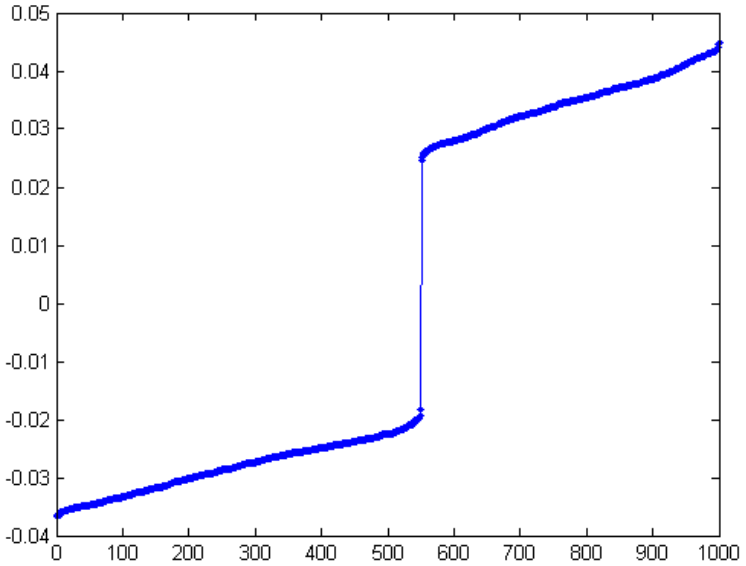


Example:

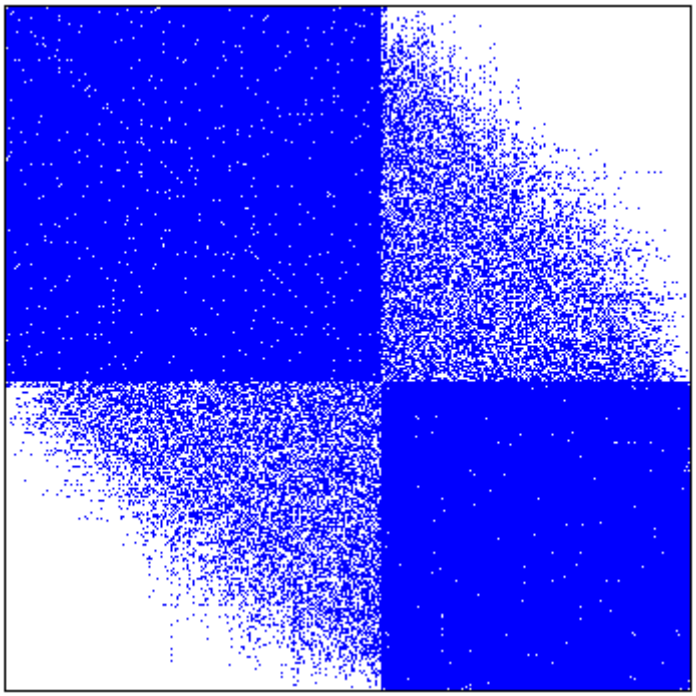


Adjacency matrix

Sorted eigenvector

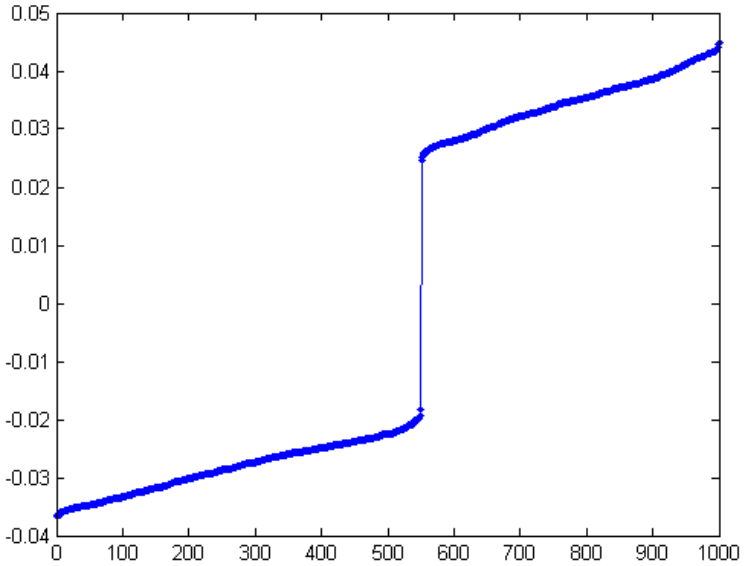


Example:

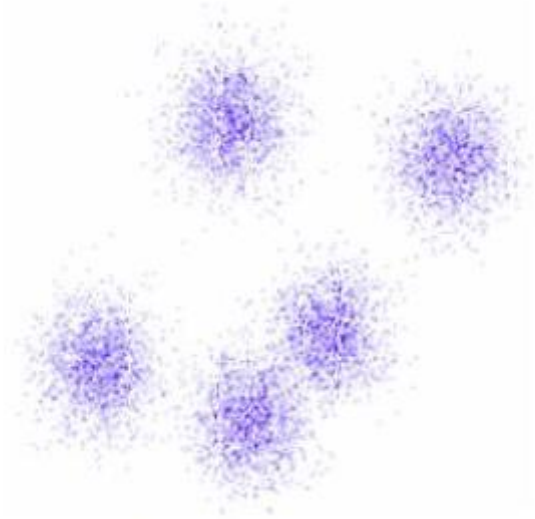


Sorted adjacency matrix

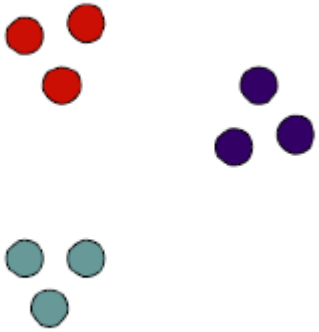
Sorted eigenvector



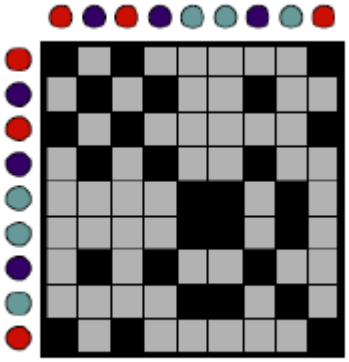
This applies beyond graphs



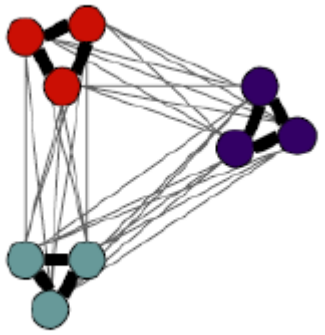
This applies beyond graphs



Data

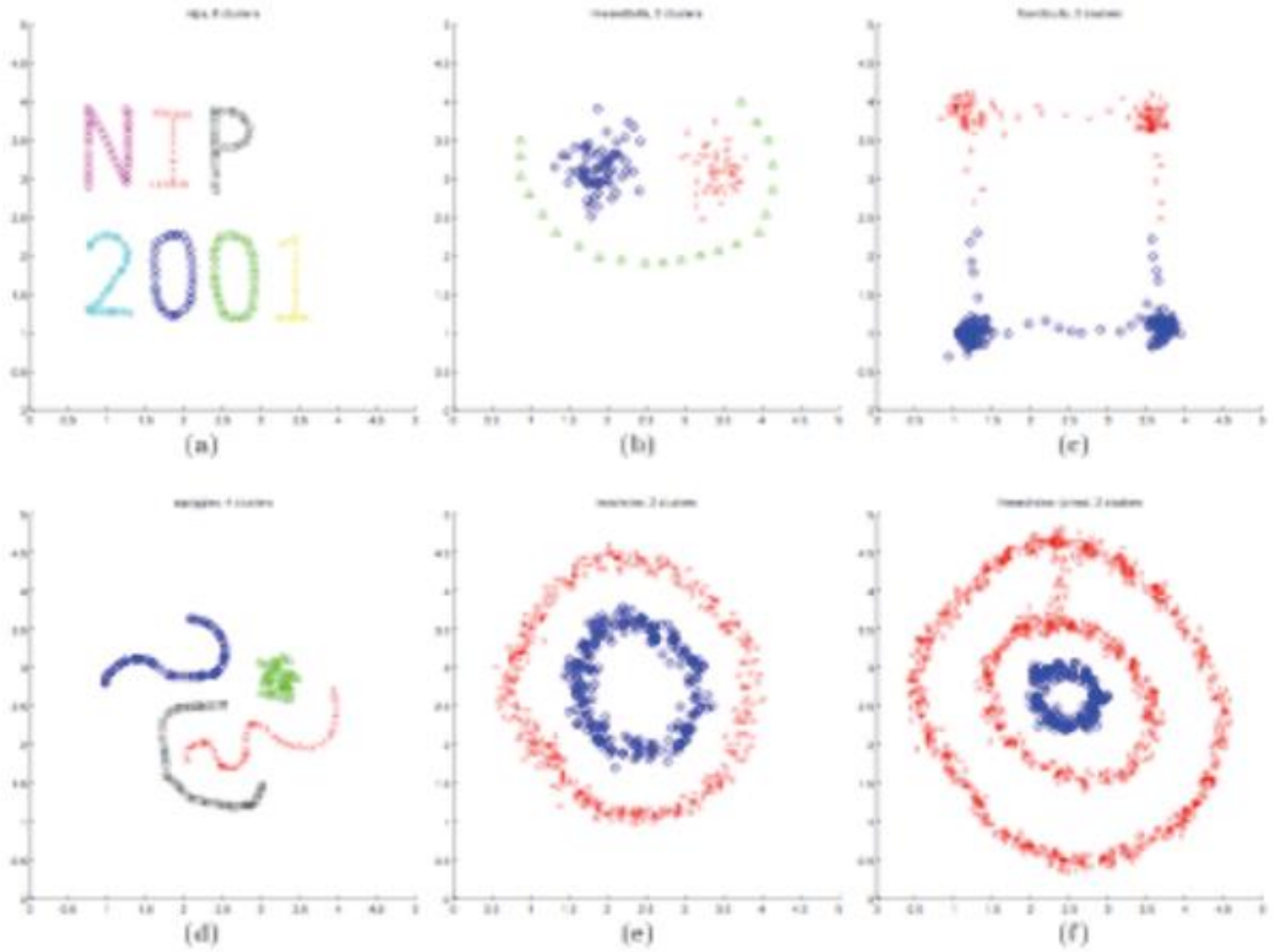


Similarities



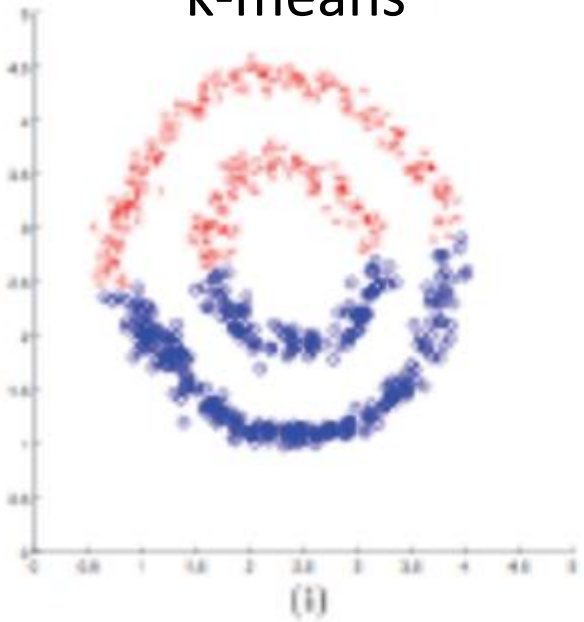
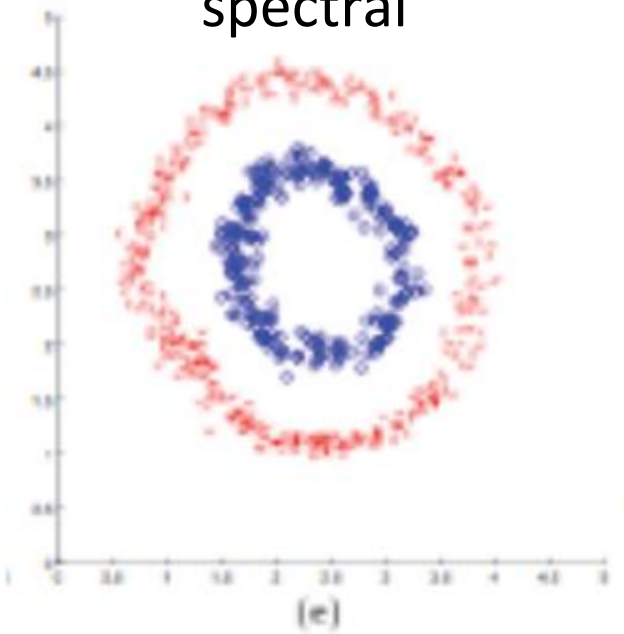
Similarity graph

Examples (Ng et al. 2001):



Examples (Ng et al. 2001): k-means vs. spectral

k-means



spectral