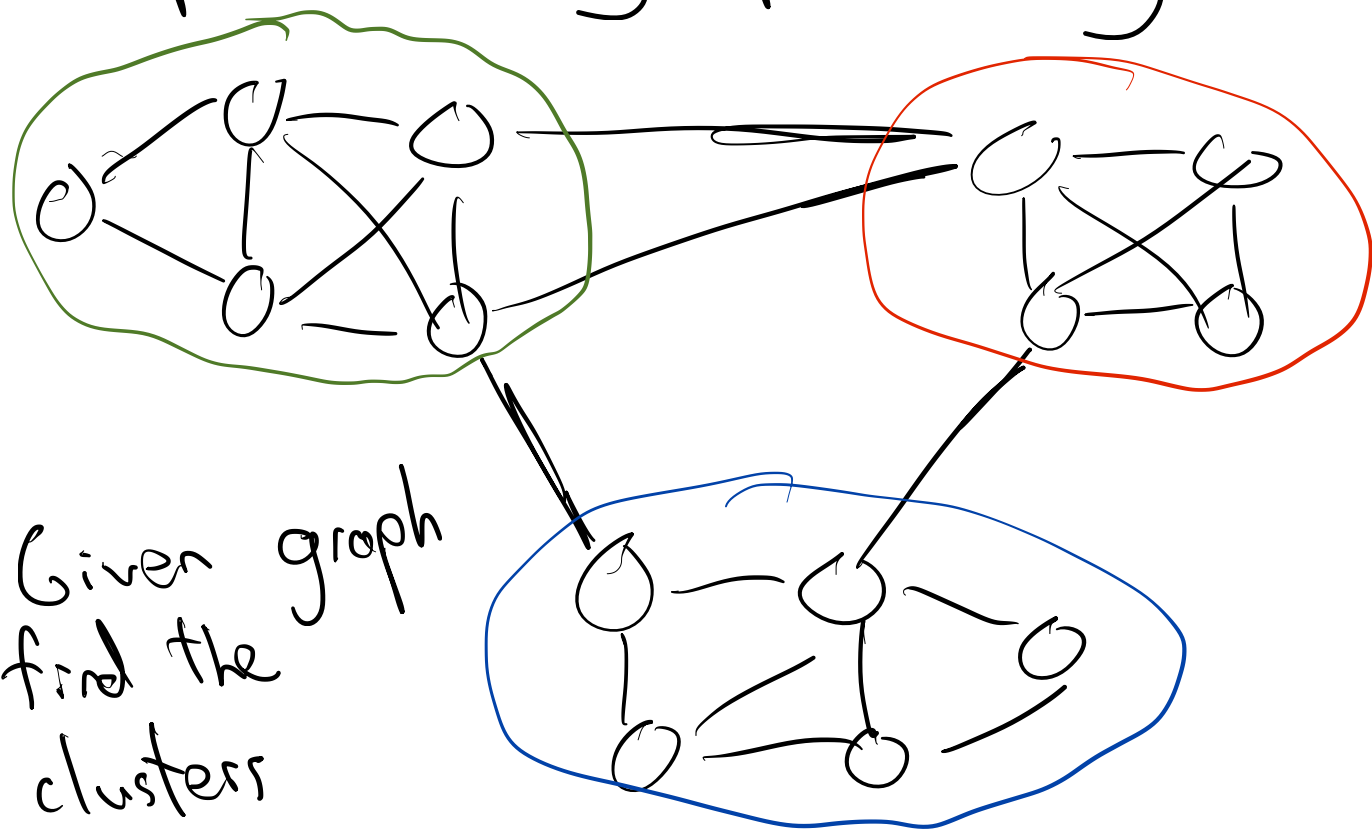


March 10, 2020

Graph clustering / partitioning / community detection



Given graph
find the
clusters

mesoscopic

(no labels given)

lots of methods! (see surveys)

Our focus: spectral methods

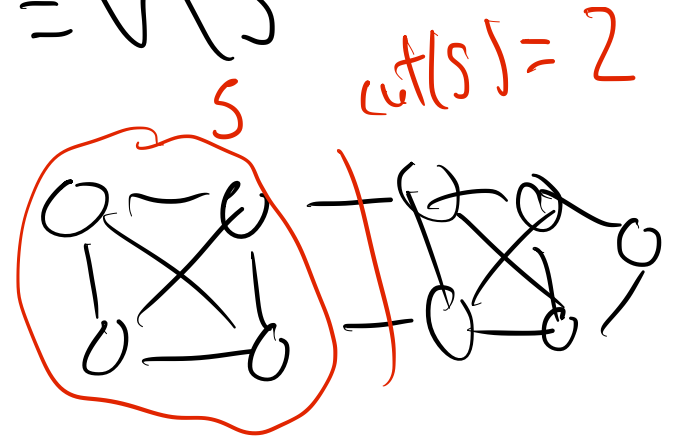
- communities in social networks
- modules in biological networks
- papers on a topic in citation network
- brain regions

$G = (V, E)$ undir. $|V| = n$ $|E| = m$

partition V into S and $\bar{S} = V \setminus S$

$\text{cut}(S) = \#$ of edges leaving S

$$= \sum_{i \in S, j \in \bar{S}} A_{ij}$$



$$\text{Ratio Cut}(S) = \frac{\text{cut}(S)}{|S|} + \frac{\text{cut}(\bar{S})}{|\bar{S}|}$$

Test vectors: $x_i = \frac{1}{\sqrt{n}} \begin{cases} \sqrt{|S|/|\bar{S}|} & i \in S \\ -\sqrt{|S|/|\bar{S}|} & i \in \bar{S} \end{cases} \quad (*)$

Claim: $x^T L x = \text{RatioCut}(S)$ under $(*)$

