Networks

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The menu

- ▶ LAPOP assignment do today in lecture
- ▶ Introduction to networks

NETWORKS

Milgram's lost letter experiment

- ▶ **Small world problem:** What is the probability that two people selected at random from a large population will know each other?
- ▶ **Step 1:** "Random" people in Kansas and Omaha asked to mail a package to a target person in Massachusetts
- ▶ **Step 2:** If they know the person, they send it directly. Otherwise, they send it to someone they know (on a first-name basis), who, in turn, does the same.
- ▶ The average chain has 5.5 links.

# ICG: Six degrees of Kevin Bacon

Why study networks?

1. Social and political interactions are *shaped* by the structure of relationships
   - Trade
   - Sharing (information, favors, risk)
   - Transmission (disease, opinion)
   - Technology adoption
   - Political alliances, trade alliances
2. Social networks influence behavior
   - Crime, employment, voting

What is a network?

- Nodes (or vertices): $\{1, ..., N\}$
- Edges (or links): Represent relationships. Can be represented in a matrix, g
  - Undirected (the relationship is symmetric): love, friendship
  - Directed (the relationship is asymmetric): love, friendship
- Network (or graph): (N, g)

- Quiz: How many possible networks of 20 people?

Matrix and graph

	1	2	3	4	5
1	0	1	0	1	1
2	0	0	1	0	0
3	1	0	0	1	0
4	0	0	0	0	1
5	1	0	0	0	0
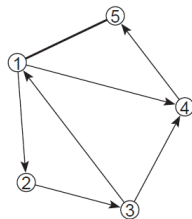
Describing networks

▶ Node-level measures
  ▶ Degree: Number of links of a node (in-degree/out-degree).
  ▶ Eigenvector centrality: A node is more central if it is linked to more central nodes.
  ▶ Closeness: Inverse of the sum of the distance from one node to all the other nodes.
  ▶ Betweenness: A node is central if it lies on several shortest paths among other pairs of nodes.
▶ Network-level measures:
  ▶ Average degree, eigenvector, closeness, etc.
  ▶ Diameter: Longest shortest path in a network.
  ▶ Clustering coefficient: Number of "triangles".

▶ Apply it to the Padgett marriage network in R!

EXAMPLES

Florentine Marriages

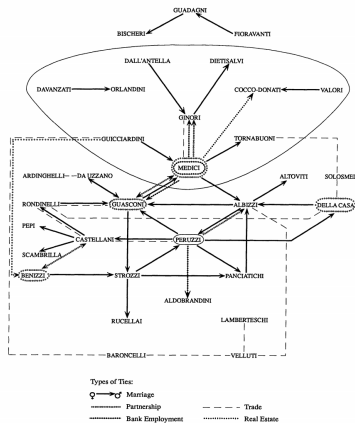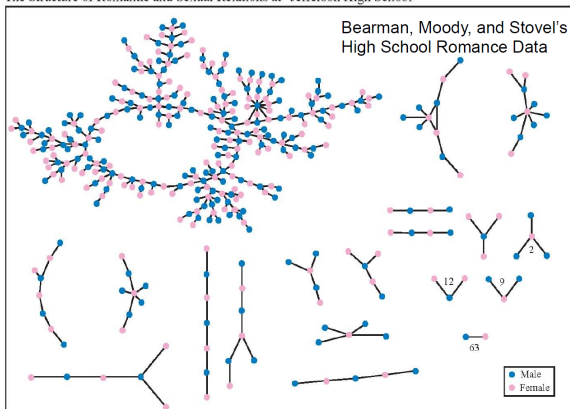FIG. 2a.—Marriage and economic blockmodel structure (92 elite families)

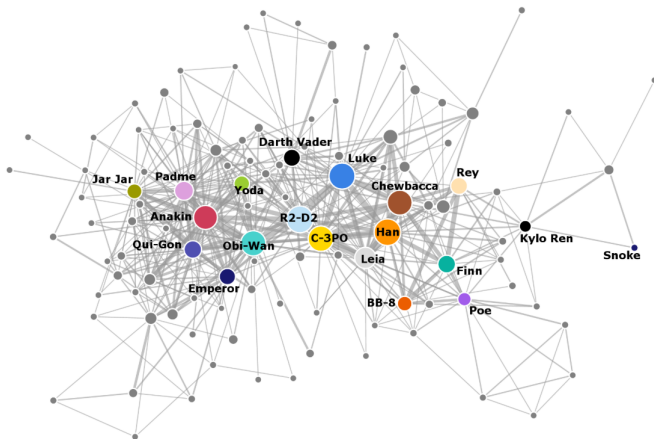Figure 1.2.1 15th Century Florentine Marriges Data from Padgett and Ansell [491] (drawn using UCINET)

High School Romance

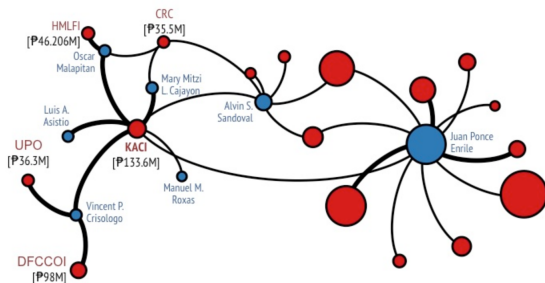The Structure of Romantic and Sexual Relations at "Jefferson High School"

Bearman, Moody, and Stovel's
High School Romance Data

Star Wars

- ▶ Link

Philippines Corruption Scandal
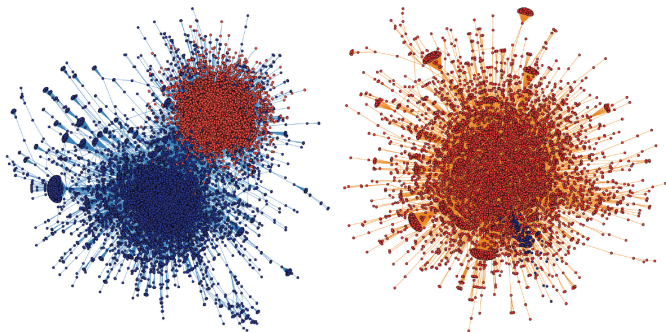
Political polarization on Twitter

Figure 1: The political retweet (left) and mention (right) networks, laid out using a force-directed algorithm. Node colors reflect cluster assignments (see § 3.1). Community structure is evident in the retweet network, but less so in the mention network. We show in § 3.3 that in the retweet network, the red cluster A is made of 93% right-leaning users, while the blue cluster B is made of 80% left-leaning users.

► Homophily

Legislative Cosponsorship in the US Congress (Fowler 2006)
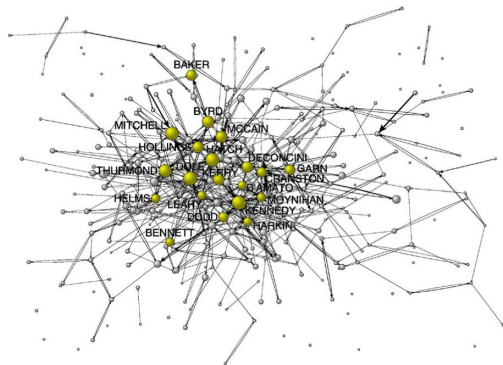

Fig. 4. Strongest weighted cosponsorship ties in the full Senate network, 1973–2004. Note: Size of each vertex is proportional to the Senator's connectedness score, the width of each arrow is proportional to the weighted quantity of bills cosponsored w_{ij} (values of $w_{ij} < 10$ not shown) and vertices that represent the top 20 Senators are identified by name. Figure drawn using Kamada–Kawai algorithm in Pajek (de Nooy et al., 2005).
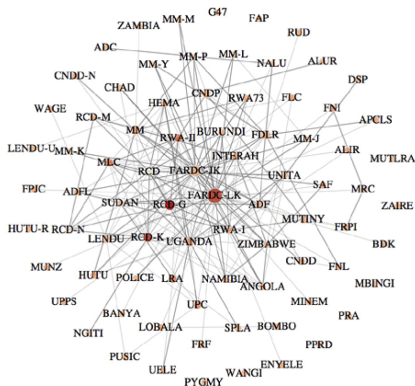
Rebel groups in DR Congo (Koenig et al. 2017)

FIGURE 2.—The figure displays the network of alliances and enmities between 80 fighting groups active in the DRC over the 1998–2010 period.

Rumors, Kinship Networks, and Rebel Group Formation (Larson and Lewis 2018)

"Rumors started by aspiring rebels aim to cast the early rebellion in a favorable light. When these rumors reach enough people quickly, they can convince civilians both that the rebels are worthy of support, and that enough others will keep quiet to make secrecy valuable. Civilian networks with certain properties –low fragmentation and short paths–facilitate this process, providing rebels with a shield of secrecy behind which they can attain viability. We draw on ethnographic evidence to argue that in rural, Sub-Saharan Africa, kinship networks that form in homogeneous areas tend to feature low fragmentation and short paths, while those that form in heterogeneous areas do not. Because of this difference, attempts at organized rebellion are more likely to succeed when they occur in homogeneous areas; in heterogeneous areas, civilians have greater incentive to provide information to the government about the vulnerable rebels forming in their midst, leading to the rebels' demise before they present a substantial threat."

Family Networks in Mexico (from my own research!)
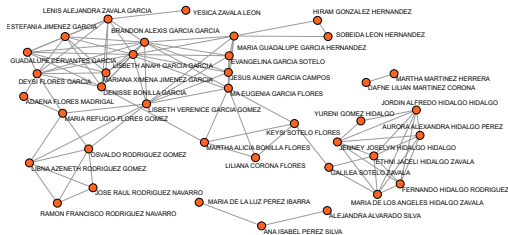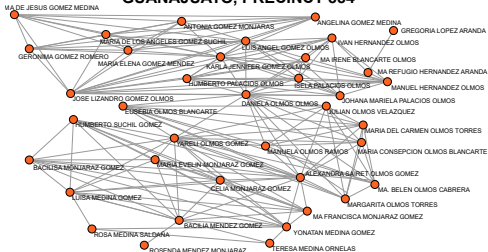
What have we learned?

- ▶ Networks basics
- ▶ Examples from political science and other domains
- ▶ Basic implementation and visualization in R