Defining and Representing Networks

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Announcement

- We will cover Lab1a in tomorrow's lab session. Please attend *either* the 12-12:50 or the 3-3:50 session via Zoom.
- Instructions of *My Dream Team* survey posted on Canvas. Please complete the survey by **next Wednesday, Jan 19th, 6:30pm**.
- Return to in-person class next week.

Feedback

Can you suggest anything we could do to make this class more helpful or engaging to you?

3 responses

I think everything worked well the first week.

love to go deep in technical stuff (data science application)

More engagement on the students side is needed, especially in a 3-hour lecture! This can be in a form of discussions (or breakout rooms on Zoom).

Feedback

Let us know any additional feedback and suggestions (e.g. class format, technologies, readings, activities, etc.) that you have. Thanks!

3 responses

Perusall is a nice interactive addition to the readings. It's nice to have the teams platform but since I don't use it otherwise, it is a little bit difficult to remember to check it. I really appreciate that all assignment to-do's are still visible as reminders on Canvas.

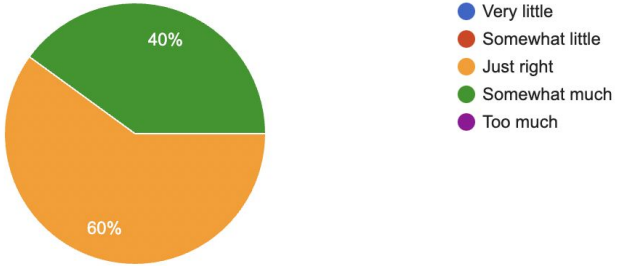
love to hear about the use of network science in soccer analytics

None!

Feedback

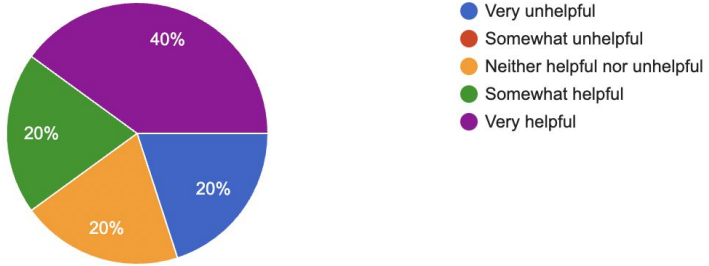
How was the amount of readings for this week?

5 responses



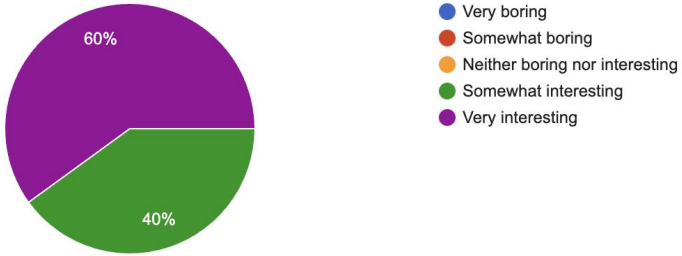
Quality of readings

5 responses



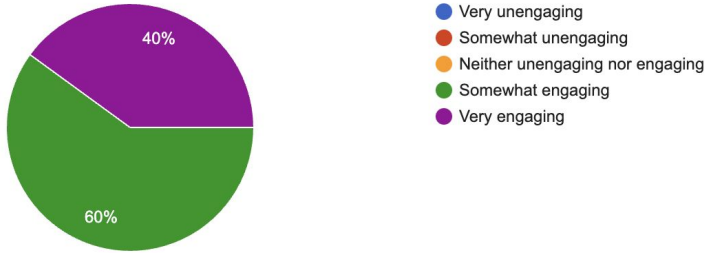
Class lecture

5 responses



Class interaction/discussion

5 responses



Networks in the News

Andrew Torres

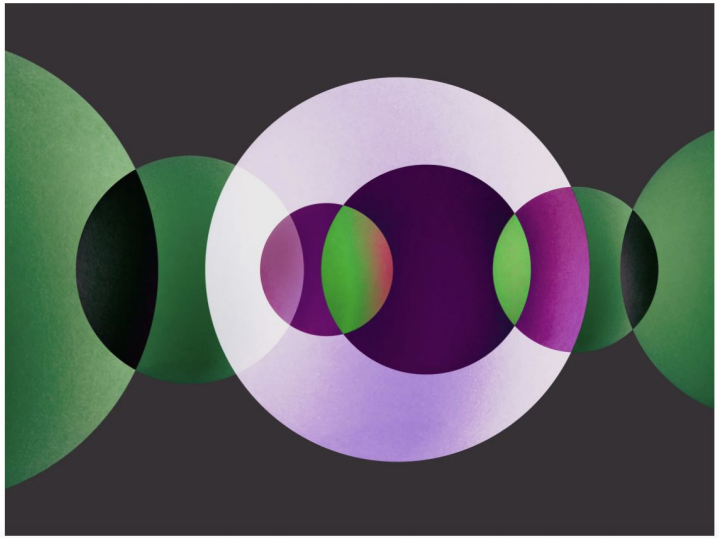
The arguments put forth in this article and the study suggest women have to work harder and smarter than men, which is an unfortunate reality in today's professional world. The flip-side is that women can make meaningful connections that are likely to be stronger and longer lasting than those of men. This article did not mention whether this general concept of needing an extra close network applies to other minorities, but my intuition would suggest that it does. This is why there are affinity groups and pre-professional clubs for minorities and historically underrepresented/marginalized communities. The catch is that limiting oneself to only the closer networks of just women or just Latinos or just LGBT+ does not help – one must always have that broad, well-connected network.

https://www.wired.com/story/women-leadership-job-networking/

EMILY DREYFUSS SCIENCE 01.21.2019 03:00 PM

For Women Job Seekers, Networking Like a Man Isn't Enough

A new study finds that male and female job seekers need different kinds of peer networks to get ahead.



GETTY IMAGES

Networks in the News

Other Comments:

Garrett Lee Yesterday 10:41 PM 👍 1

When I read this article and Andrew George Torres's comments, I visualized these networks as different layers. One layer would be your normal academic network, a second layer could be your interest group network, and the third would be your cultural/ethnic community network, etc. The point being that the more "layers" you are, you are a part of a diverse group of people. It seems that an individual who has "high centrality" in many diverse networks will likely succeed the most. One network can help to get one job, but you never know when the others might help!

Hanhee Yang 2:21 AM Edited 👍 1

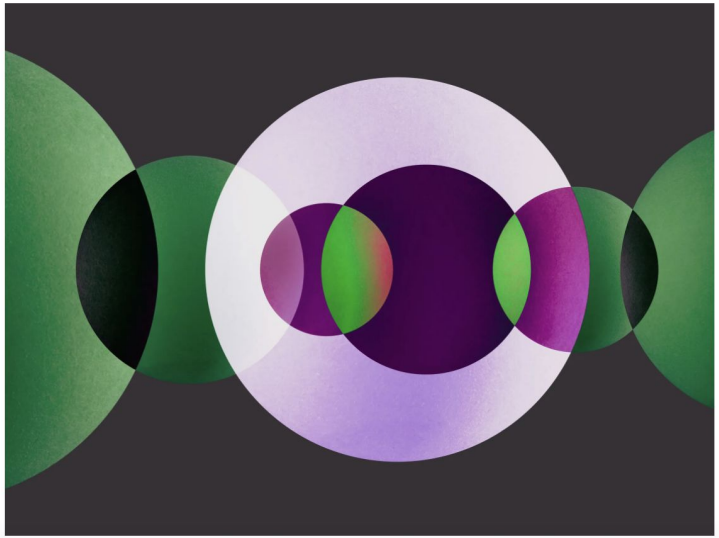
This article reminded me of the cultural phenomenon of women going to bathrooms together. Women go to bathrooms together due to many different reasons such as being able to making sure they look good, safety, gossip, confidence boosting, etc. Women's relationships in society seem to be more support-based compared to men. I wonder what the reasons for this support-based relationships are. Maybe it is the societal pressures of a woman, or the biological differences/struggles of women that others can easily relate to?

However, this support based relationship between women truly seem to be a reason why only women seem to benefit from the networking from inner circles. This brings up the question of the small world theory. I really do think now, that the strength of weak ties is exponentially increased when the sharing of knowledge and support is apparent.

EMILY GREYFUSS SCIENCE 01.21.2019 03:00 PM

For Women Job Seekers, Networking Like a Man Isn't Enough

A new study finds that male and female job seekers need different kinds of peer networks to get ahead.



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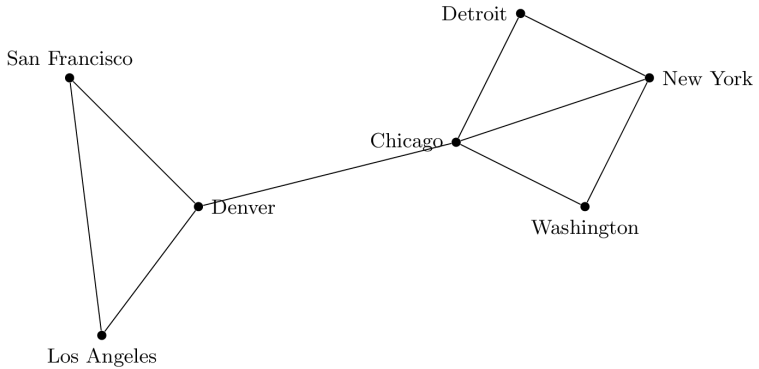
Networks in the News

Garrett Lee:

Let's visualize this a little bit. Take a look at this small graph. There are two central nodes that represent hub airports such as JFK (New York), ORD (Chicago), or SEA (Seattle) that connects all other small airports. Like our situation discussed above, imagine a central node (such as ORD) gone due to weather conditions: the airport is shut down temporarily. This means that (in this network at least), there is no way to get from one node to another if the only way is to go through the central nodes. Passengers either need to rely on a different network or wait until the network is restored.

If this is something that interests you, there is a mobile game that tackles the issue of flight network disruption, and it is called OptiFlight. The mobile game asks you to draw routes between real airports and introduces disruptions in the middle. The question is, how will you deal with these network disruptions? Will you design a flight network that is resilient to such unpredictable events?



abc NEWS

New Year's Day flight cancellations: 2,500 and counting

Staff COVID cases and bad weather resulted in Saturday's cancellations.

By Nadine El-Bawab
January 1, 2022, 3:10 PM • 4 min read

https://abcnews.go.com/US/years-day-flight-cancellations-2000-counting/story?id=82031889

SONIC
advancing the science of networks in communities

Objectives for Today

- In order to understand various real-world and digital- social networks, we need ways to describe and compare them.
- Today, we will discuss methods of defining networks, visualizing networks, and describing global properties of networks.

What is a network ?

A network is a set of nodes and collection of potential links between these nodes

Actors & relations

- **Actors (nodes, vertices)**
  - People, groups, organizations, communities, nation-states, web sites, documents, tags …

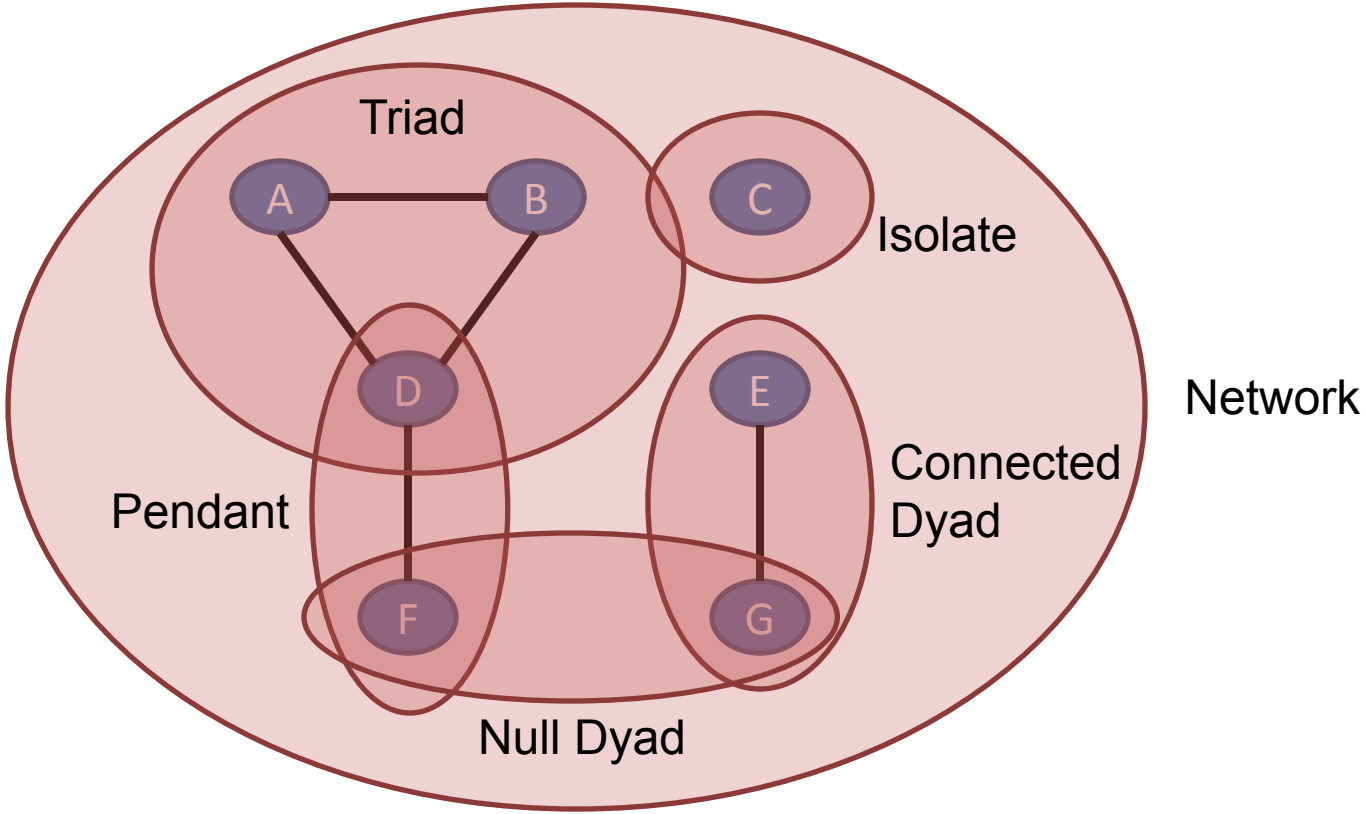
Actors & relations

- **Relations (links, ties, edges)**
  - Evaluations of one person by another (friendship, liking, ...)
  - Transfers of material resources (lending, donations, ...)
  - Association or affiliation (membership, attendance, …)
  - Behavioral interaction (communication, intercourse, …)
  - Movement between places or statuses (migration, mobility, …)
  - Physical connections (roads, routers, …)
  - Formal relations (authority, supply chain, …)
  - Biological relations (kinship, descent, …)
  - Retrieving and publishing documents
  - Tagging Photos

Are the social ties of NU Wildcats who have traveled together on a space flight to Mars a network?

A. Yes

B. No


Triad
A
B
C
Isolate
D
E
Network
Connected
Dyad
Pendant
F
G
Null Dyad

Three types of networks

- **Egocentric**
  - The network surrounding an individual
- **Sociocentric**
  - The network of a collection of individuals known in advance
- **Open-system**
  - The network of a collection of individuals not known in advance

Sociomatrix

	A	B	C	D	E	F	G
A	-	1	0	1	0	0	0
B	1	-	0	1	0	0	0
C	0	0	-	0	0	0	0
D	1	1	0	-	0	1	0
E	0	0	0	0	-	0	1
F	0	0	0	1	0	-	0
G	0	0	0	0	1	0	-

C has **no** relationships with A,B,D,E,F,G

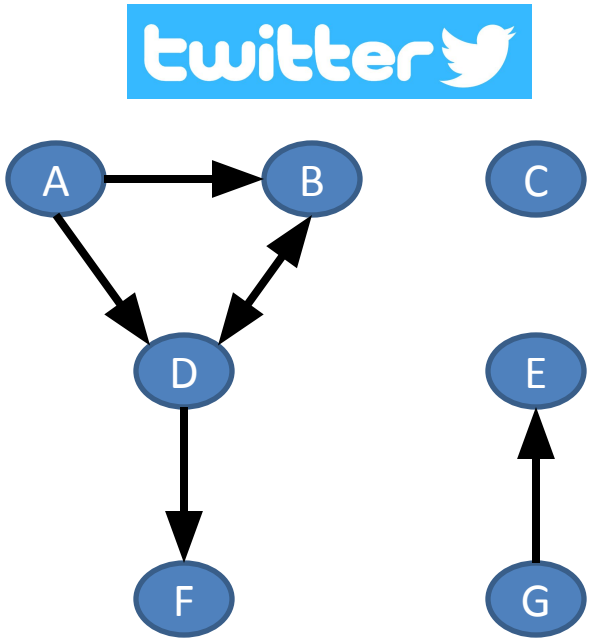
F has a relationship with D

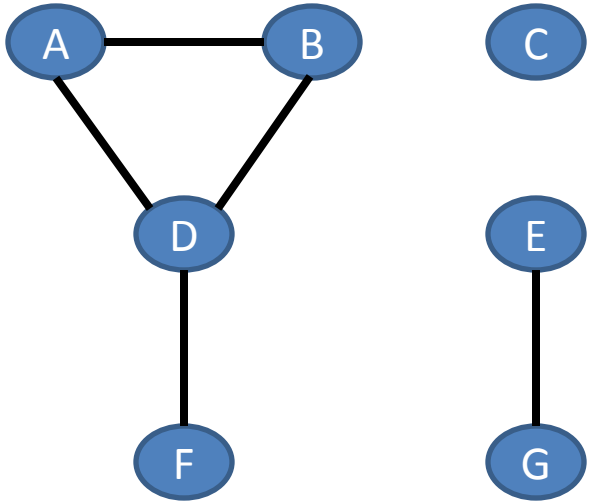
Types of Relationships

- Undirected vs. directed
- Weighted
- Multiplex

Directed & undirected

- Communication vs. friendship networks





Which network is directed?

A. Twitter follow

B. Facebook friend

C. Both

D. Neither

Undirected sociomatrix

	A	B	C	D	E	F	G
A	-	1	0	1	0	0	0
B	1	-	0	1	0	0	0
C	0	0	-	0	0	0	0
D	1	1	0	-	0	1	0
E	0	0	0	0	-	0	1
F	0	0	0	1	0	-	0
G	0	0	0	0	1	0	-

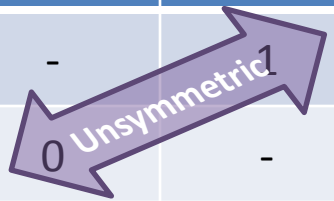
Symmetric

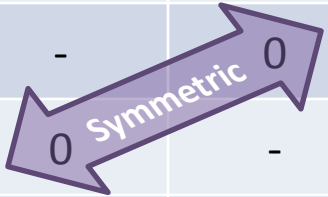
Symmetric

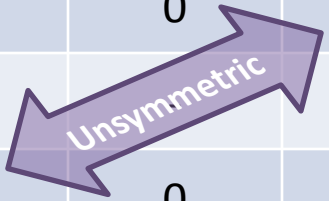
Symmetric

Directed sociomatrix

	A	B	C	D	E	F	G
A	-	1	0	1	0	0	0
B	0	-	0	1	0	0	0
C	0	0	-	0	0	0	0
D	0	1	0	-	0	1	0
E	0	0	0	0	-	0	0
F	0	0	0	0	0	-	0
G	0	0	0	0	1	0	-

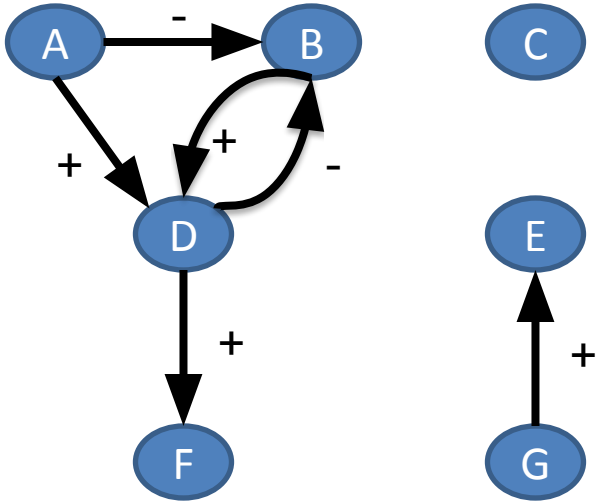


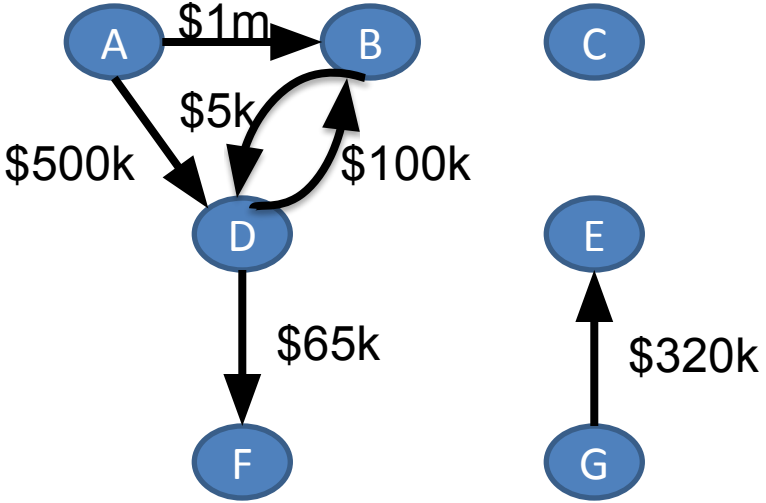




Signed & valued

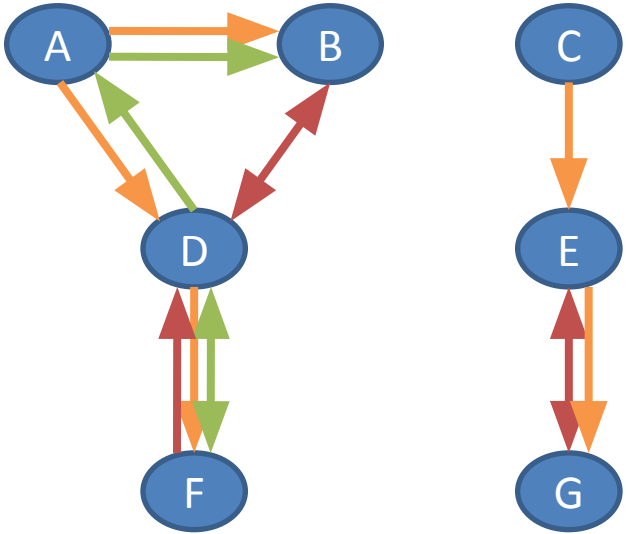
- Affect in a sorority vs. campaign financing





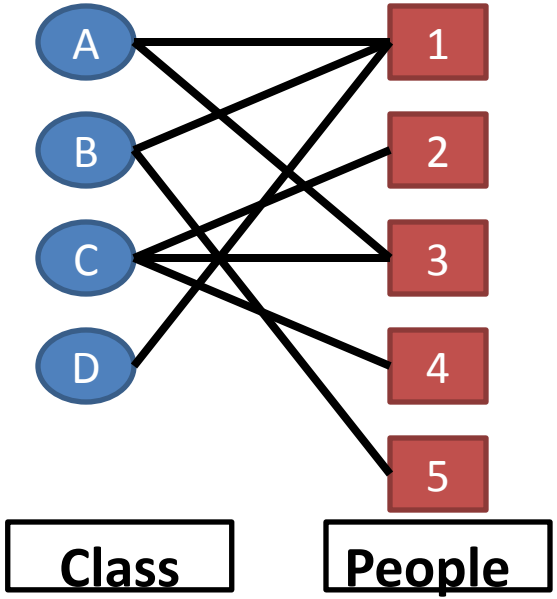
Multi-relational (Multiplex)

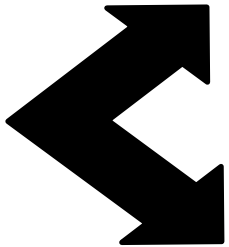
- Organizations: **authority**, **trust**, & **friendship**

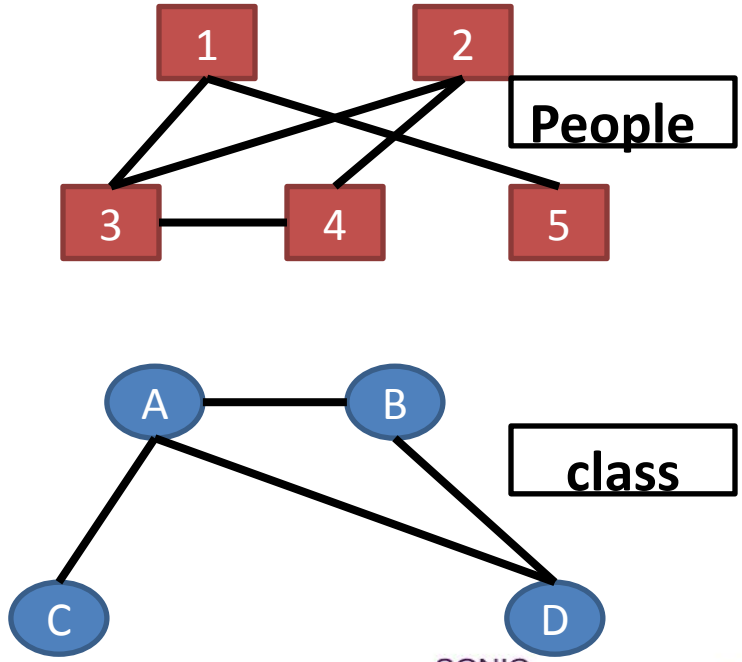


One-mode & two-mode

- Actor-actor & actor-event
- Lobbyist & co-location networks





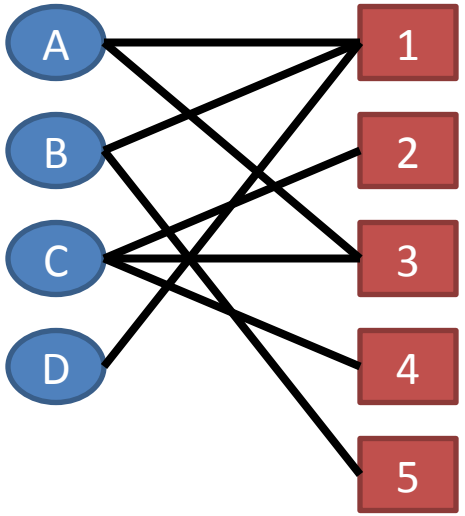


What is captured by the links in the one-mode student network derived from the two-mode class-student network?

A. Sum of the classes taken by two students
B. Number of classes taken in common by both students
C. Product of the classes taken by two students
D. Sum of the students' interest in their classes

Bipartite sociomatrix

	1	2	3	4	5
A	1	0	1	0	0
B	1	0	0	0	1
C	0	1	1	1	0
D	1	0	0	0	0



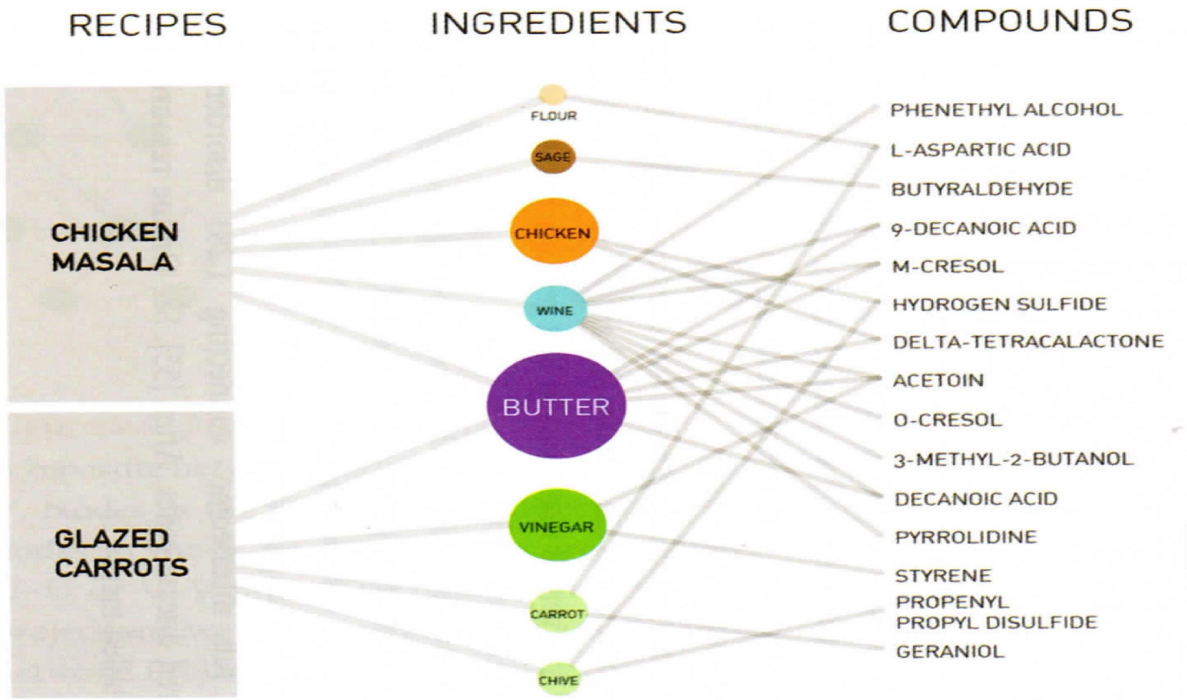
Convert Two mode to One mode (For those who know matrix algebra)

Let R_{m*n} be the matrix related to the two mode, then

- $R_{m*n} \cdot R'_{n*m} = K_{m*m}$
- $R'_{n*m} \cdot R_{m*n} = K_{n*n}$,

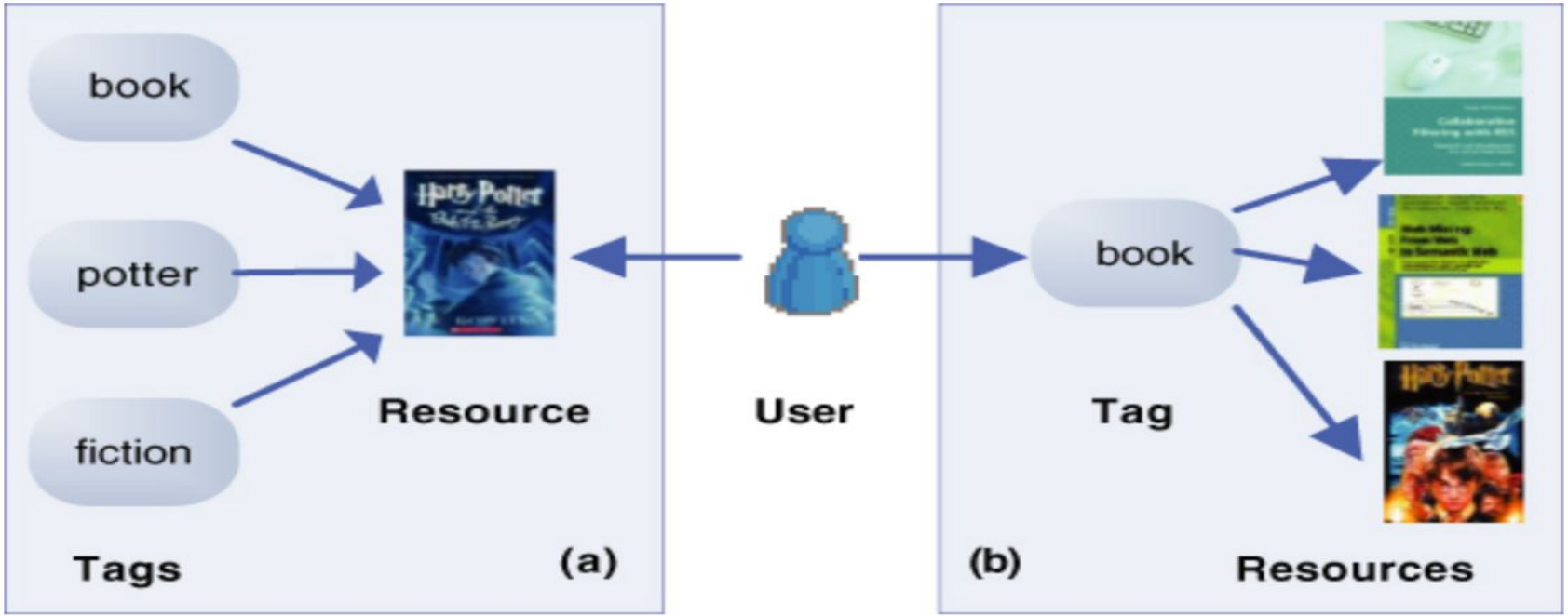
are the one mode matrices.

Tripartite Networks I



Ahn, Y.-Y., Ahnert, S. E., Bagrow, J. P., & Barabási, A.-L. (2011). Flavor network and the principles of food pairing. *Scientific Reports*, *1*, 1–7.

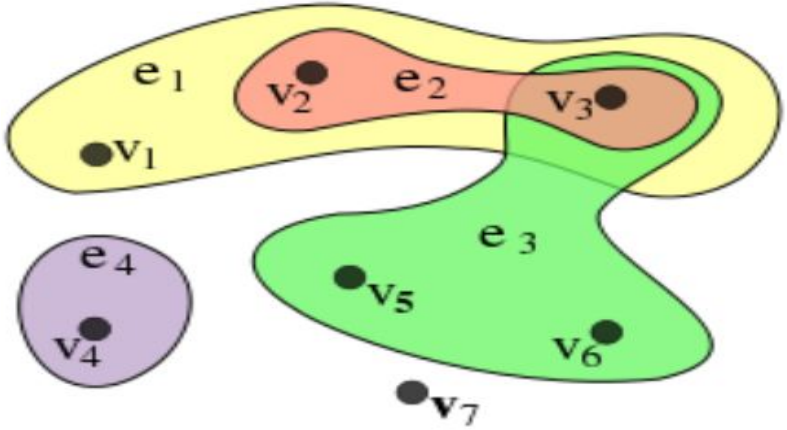
Tripartite Networks II



Hypergraphs

e – hyperedge
v – vertex

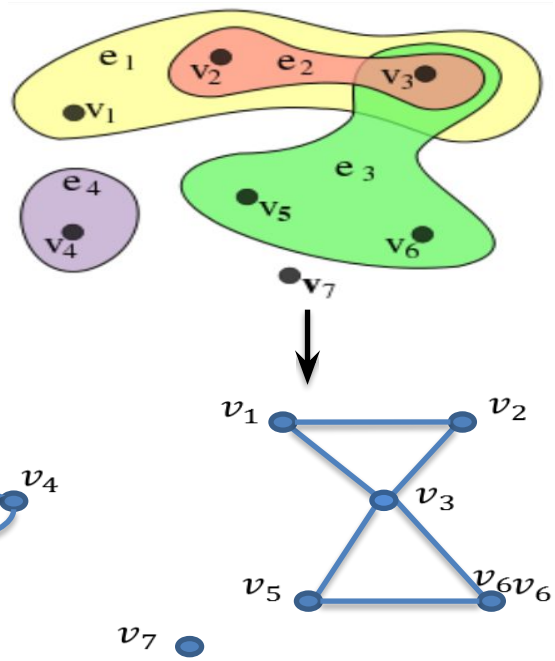
- A set of vertices and hyperedges
- Hyperedge — edge that can connect one, two, or more nodes
  - Created through a shared action



- Examples:
  - Project teams (collections of individuals on teams)
  - Co-authors (collections of authors on papers)
  - People tagging resources

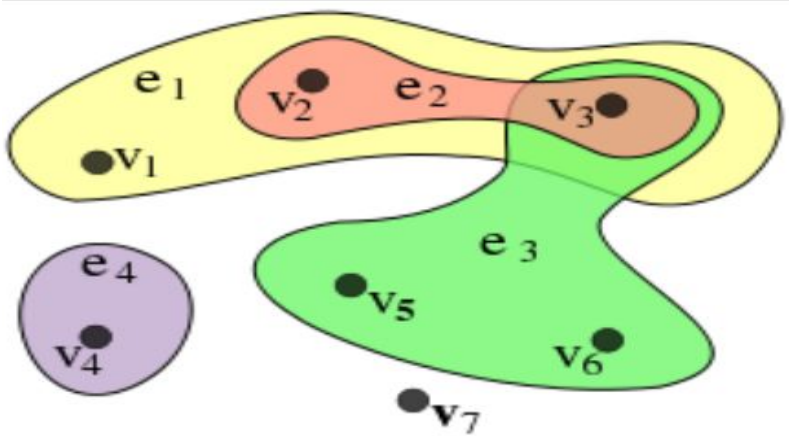
Why use hypergraphs?

- Frequently, interactions involve more than two entities
- Traditional methods of analyzing teams lose valuable information
- Hypergraphs are NOT bipartite graphs



Hypergraph Incidence Matrix

	e_1	e_2	e_3	e_4
v_1	1	0	0	0
v_2	1	1	0	0
v_3	1	1	1	0
v_4	0	0	0	1
v_5	0	0	1	0
v_6	0	0	1	0
v_7	0	0	0	0

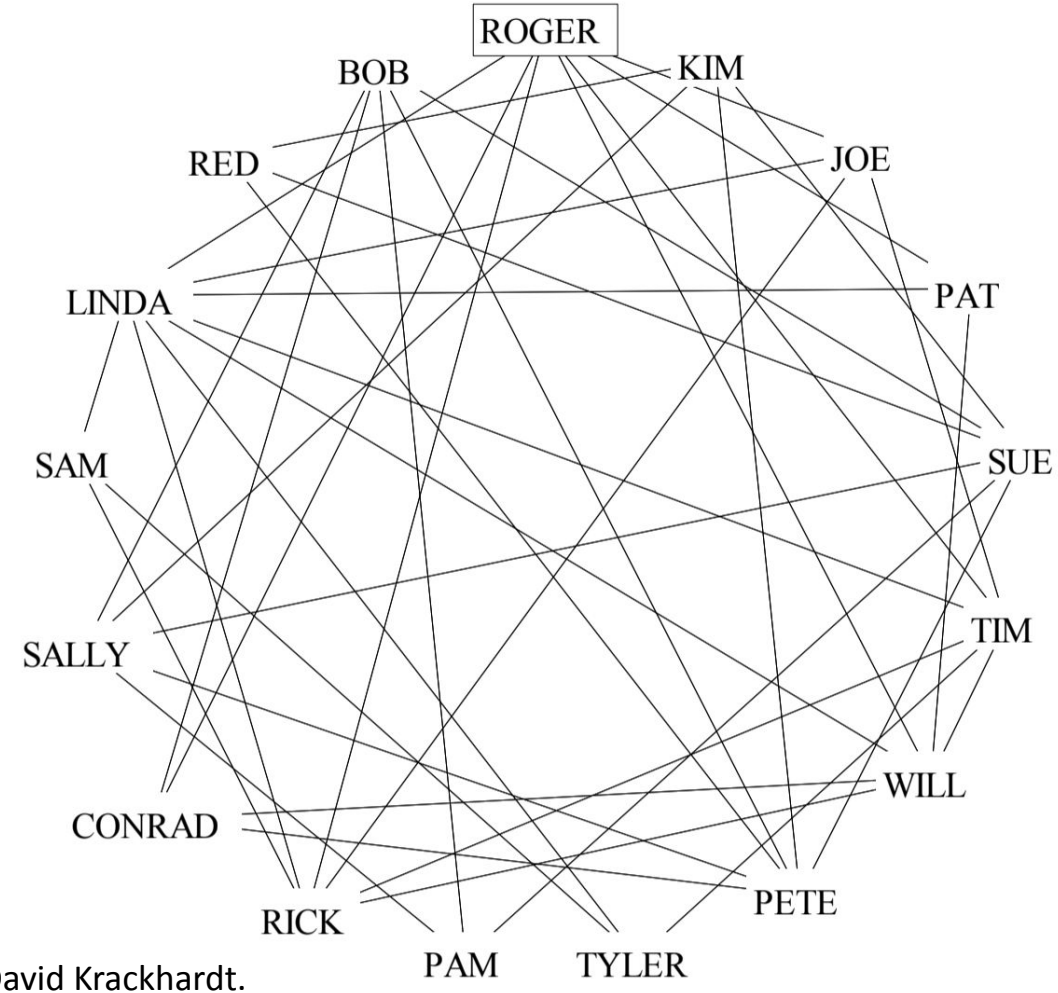


Example: Network Plotting to Understand Organizations

Strong Trust Ties

1. Who are the key (powerful) players in this organization?

2. How healthy is this organization? What, if anything, would you advise them to change?



"Life in the Pentagon" case study, David Krackhardt.

Strong Trust Ties

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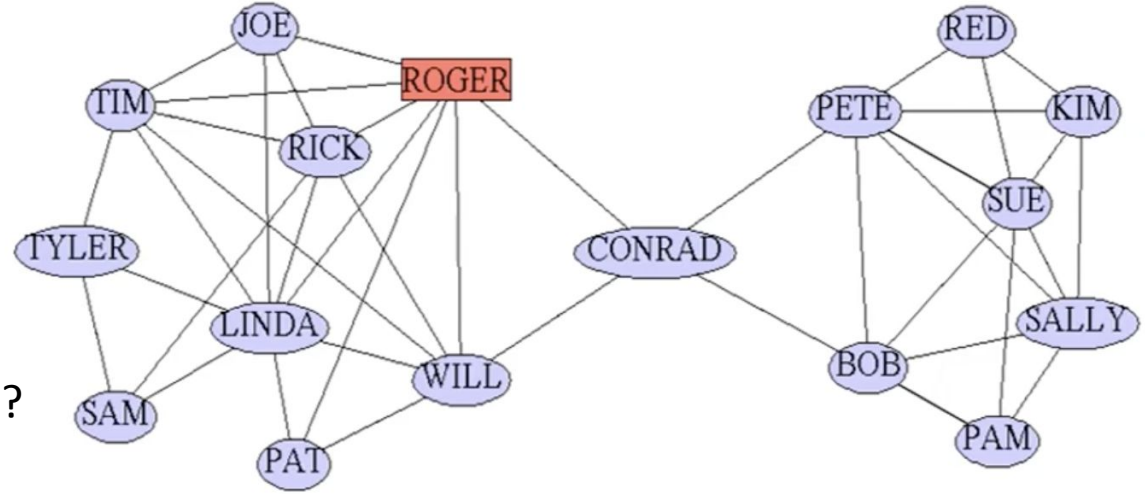

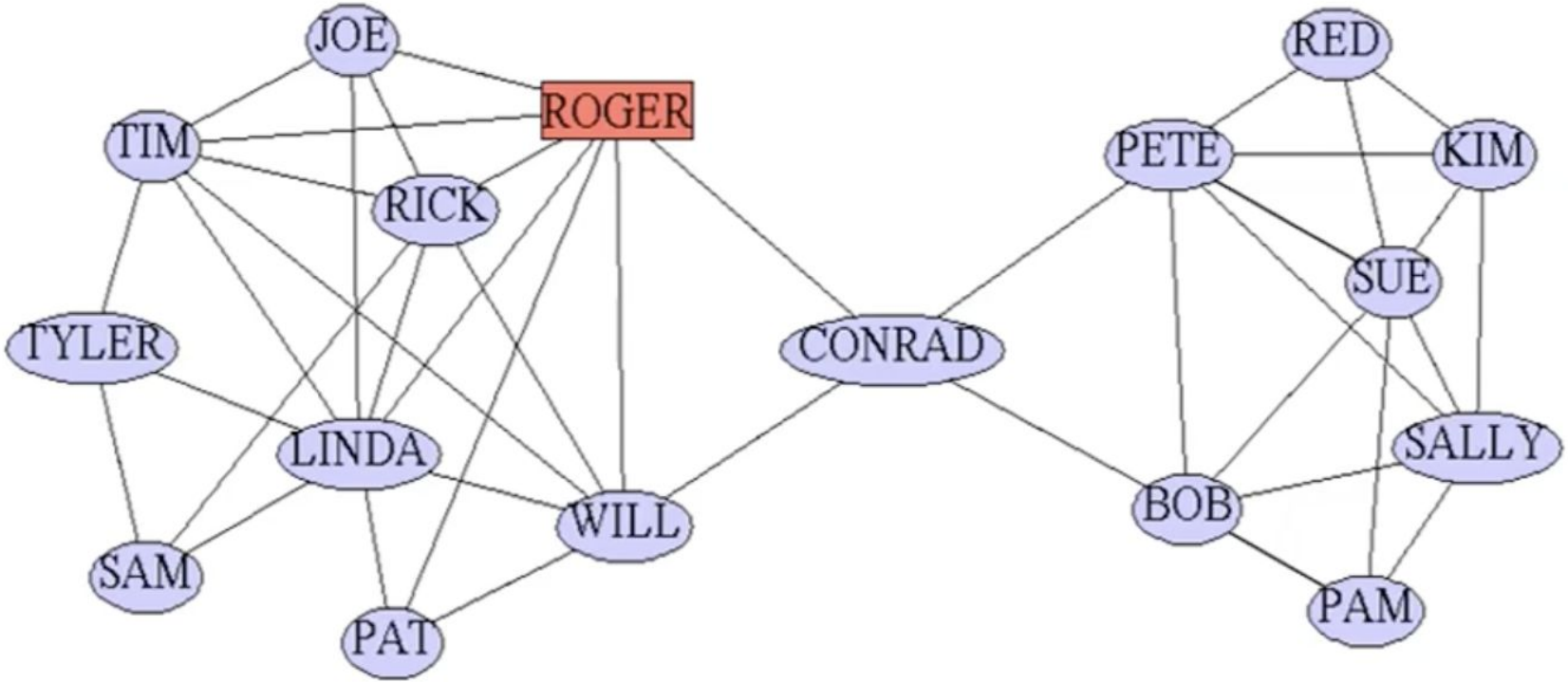

Network layouts matter.

Subjective - More “art” than “science”

In lab 1a, we will go through the process of collecting and visualizing network data