

# Social Network Analysis

## 1: Introduction

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NASP-ESLS Ph.D. Programme - University of Milan

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## Different kinds of networks

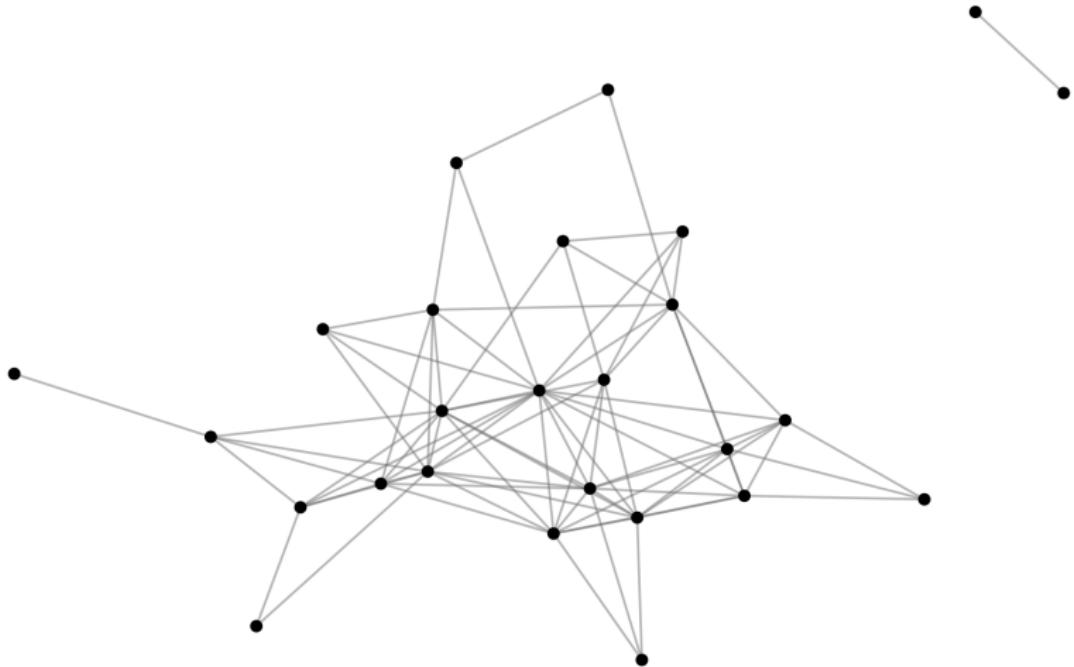
## Basic terminology

## Social relationships vs. relational data

## Outline of the course

## Different kinds of networks

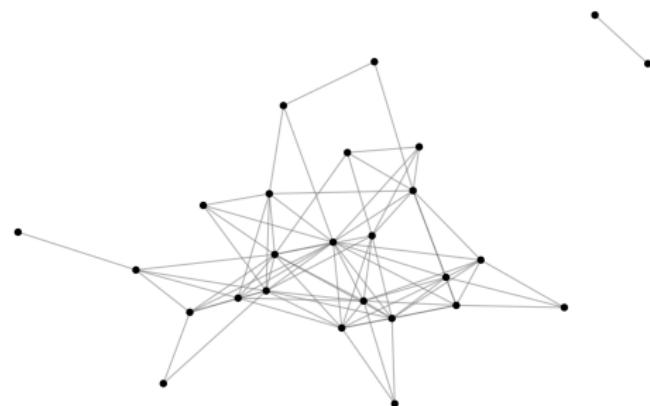
# A network



## Another network



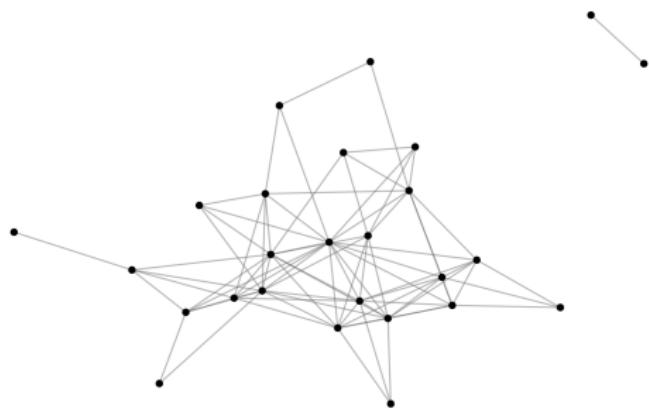
## Collaboration among professionals



- ▶ Collaboration between freelancers in a coworking space

Bianchi, Casnici, and Squazzoni (2018)

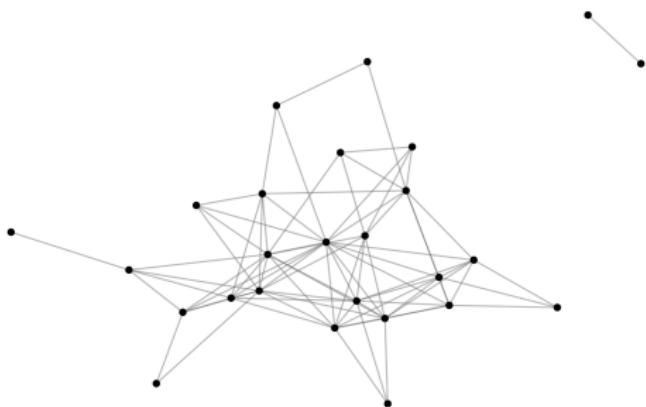
## Collaboration among professionals



- ▶ Collaboration between freelancers in a coworking space
- ▶ actors are individuals

Bianchi, Casnici, and Squazzoni (2018)

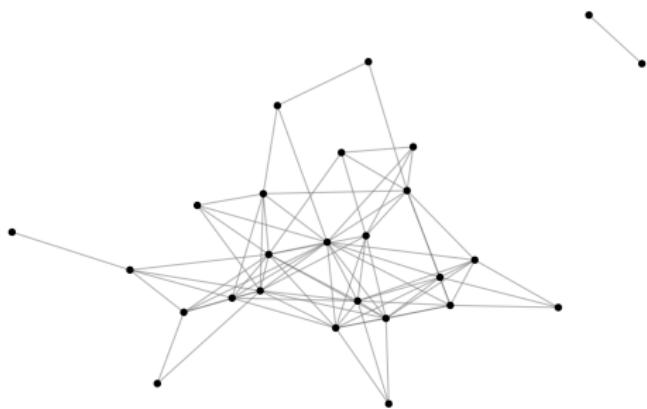
# Collaboration among professionals



- ▶ Collaboration between freelancers in a coworking space
- ▶ actors are individuals
- ▶ *undirected network*:  
 $x \rightarrow j \Leftrightarrow j \rightarrow x$

Bianchi, Casnici, and Squazzoni (2018)

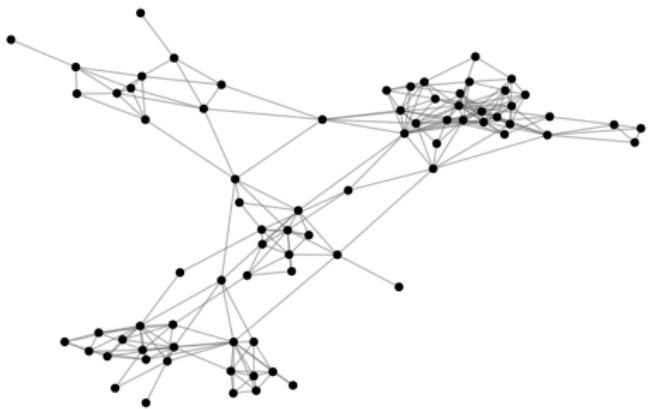
# Collaboration among professionals



Bianchi, Casnici, and Squazzoni (2018)

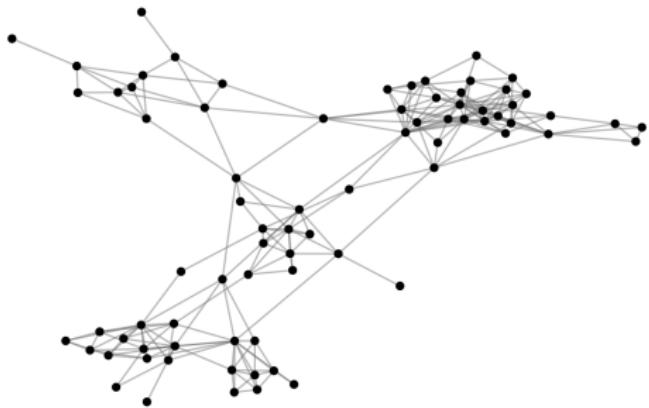
- ▶ Collaboration between freelancers in a coworking space
- ▶ actors are individuals
- ▶ *undirected* network:  
 $x \rightarrow j \Leftrightarrow j \rightarrow x$
- ▶ No organization ⇒ autonomous social selection ⇒ relatively low clustering

# Collaboration within an organization



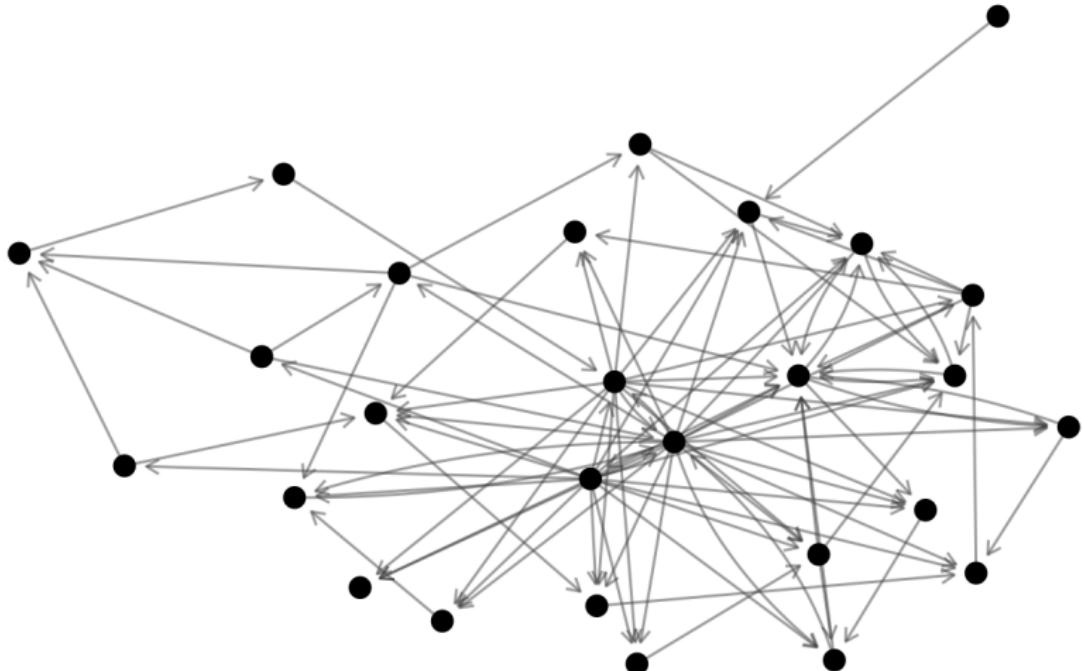
- ▶ Collaboration between employees of a publishing company

# Collaboration within an organization

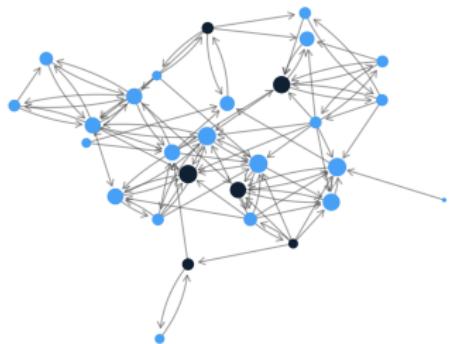
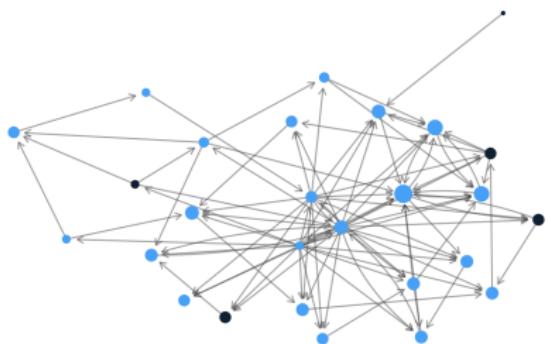


- ▶ Collaboration between employees of a publishing company
- ▶ Organization  $\Rightarrow$  formal hierarchy  $\Rightarrow$  interactions are constrained by an exogenous structure  $\Rightarrow$  more *clustering*

# A different kind of network



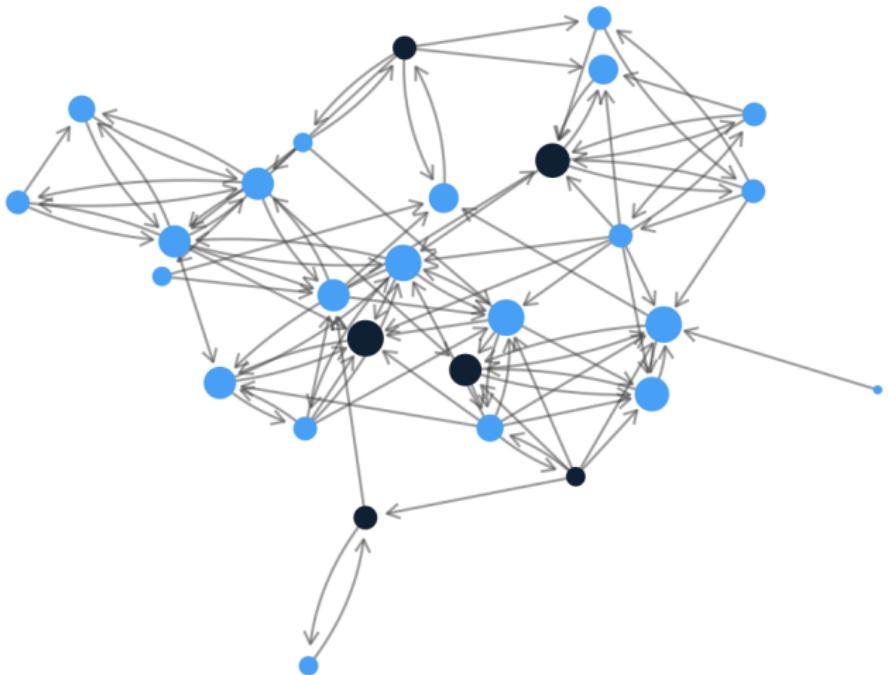
# What's the difference?



# Network 1



# Network 2



# Network 1



- ▶ Requests of professional advice between freelancers in a coworking space

# Network 1



- ▶ Requests of professional advice between freelancers in a coworking space
- ▶ *directed network*

# Network 1



- ▶ Requests of professional advice between freelancers in a coworking space
- ▶ *directed* network
- ▶ heterogeneous resource distribution → low level of *reciprocity* + high clustering  
→ social status

## Network 2



- ▶ Requests of (non-business) social support between freelancers in a coworking space

Bianchi, Casnici, and Squazzoni  
(2018)

## Network 2



- ▶ Requests of (non-business) social support between freelancers in a coworking space
- ▶ *directed network*

Bianchi, Casnici, and Squazzoni  
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## Network 2



Bianchi, Casnici, and Squazzoni  
(2018)

- ▶ Requests of (non-business) social support between freelancers in a coworking space
- ▶ *directed network*
- ▶ more homogeneous resource distribution → higher level of reciprocity

Different kinds of networks

**Basic terminology**

Social relationships vs. relational data

Outline of the course

## Basic terminology

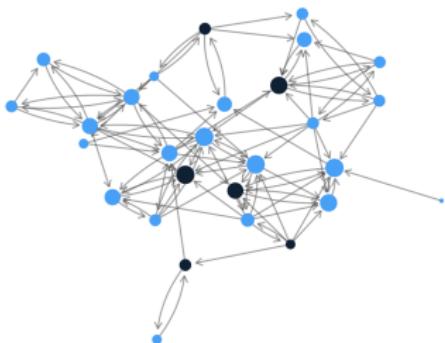
# Nodes and ties

- ▶ *graph*: a pair  $G(V, E)$
- ▶  $V$ : a set of *vertices* (sing., *vertex*) or *nodes* (usually denoted as  $i, j, k$ )
- ▶  $E$ : a set of *edges* or *links*
- ▶ Social scientists' parlance:
  - ▶  $\text{nodes} = \text{actors}$
  - ▶  $\text{edges} = \text{ties}$
- ▶ *directed graph*: *digraph* (nodes and *arcs*)

# Social network research

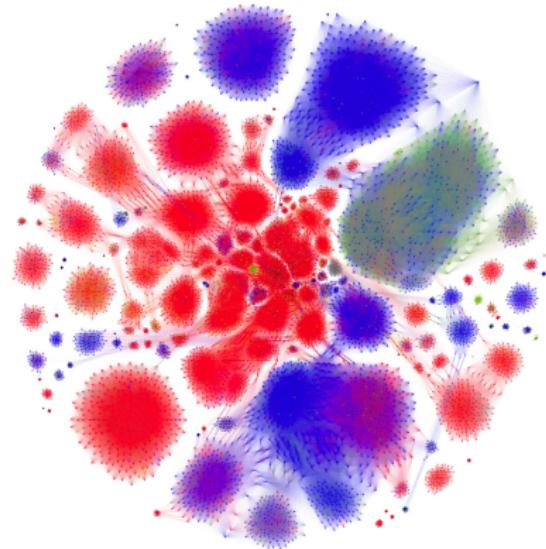
- ▶ *Social network research*: the application of a coherent set of philosophical, mathematical, and statistical tools to study social relationships (we'll see different purposes next time)
- ▶ *Social Network Analysis* (SNA): analysing network (relational) quantitative data with mathematical and statistical tools
  - ▶ computing descriptive statistics: e.g., how large is this network? is this network more or less centralized? who are the nodes that bridge these two network clusters?
  - ▶ testing hypotheses of social processes: e.g., has reciprocity affected the evolution/emergence of this network? is this network more or less homophilous than that other network?
- ▶ *Network science*: mostly used by researchers with background in physics, mostly interested in developing simple models describing many (social) networks across many fields  
**(GENERALIZATION ALERT)**

## Small and large networks



$n = 29$

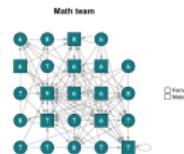
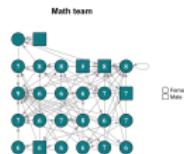
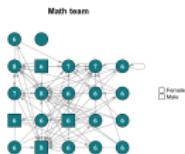
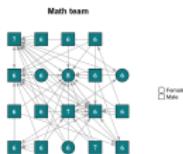
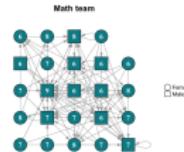
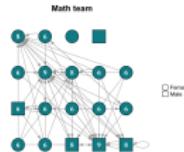
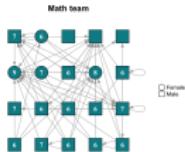
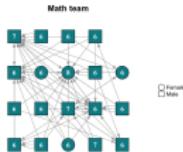
Bianchi, Casnici, and Squazzoni  
(2018)



$n = 12,019$

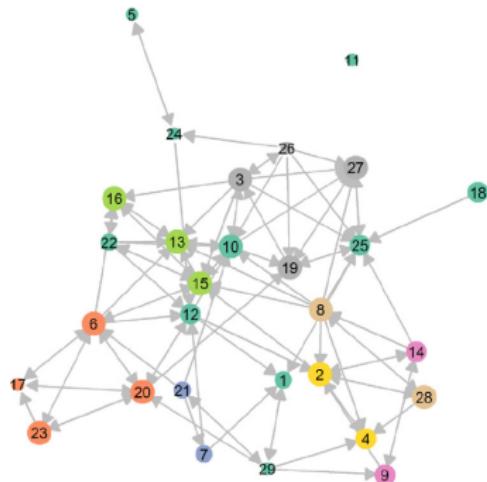
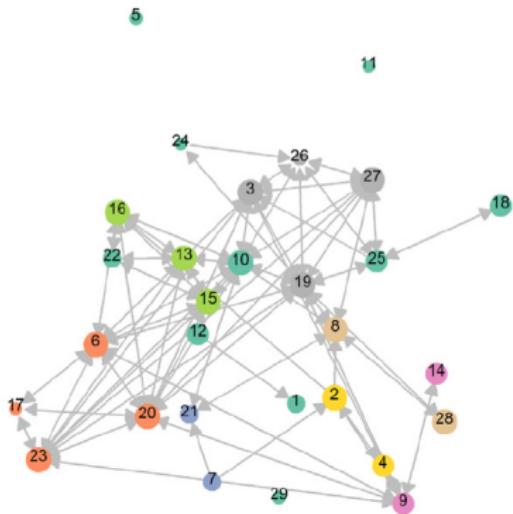
Cousin, Bianchi, and Vitale  
(2020)

# Multi-level networks



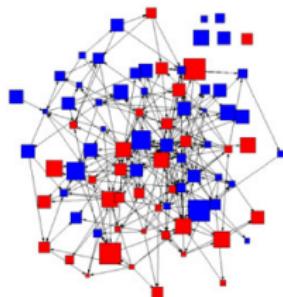
De Gioannis, Bianchi, and Squazzoni (2021)

# Multiplex networks

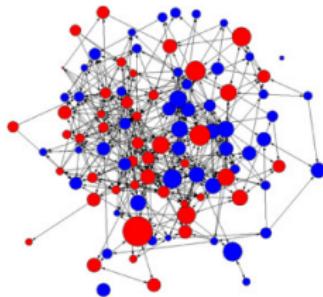


Bianchi, Casnici, and Squazzoni  
(2018)

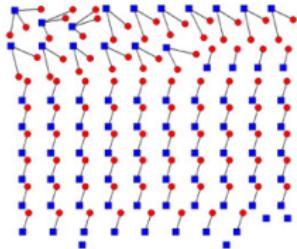
# More complex multilevel networks



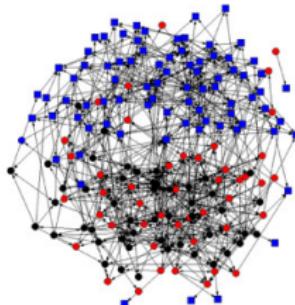
(a) Laboratory collaboration network (A)



(b) Researcher advice network (B)



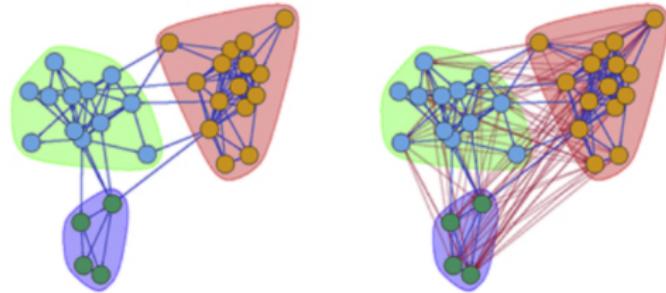
(c) Researcher-laboratory affiliations (X)



(d) Overall multilevel network (M)

Wang et al. (2016)

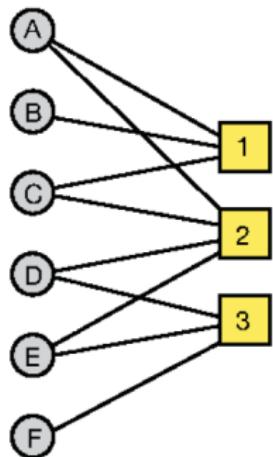
## Positive and negative ties



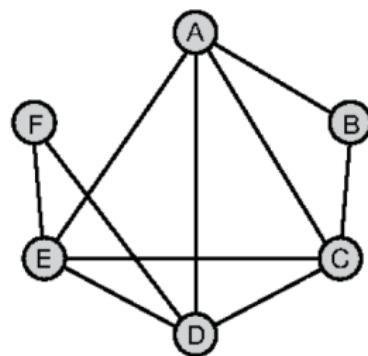
Friendship and dislike ties  
in a class of a Hungarian  
high school (Stadtfeld,  
Takács, and Vörös 2020)

## Bipartite (two-mode) networks

Physicians      Patients

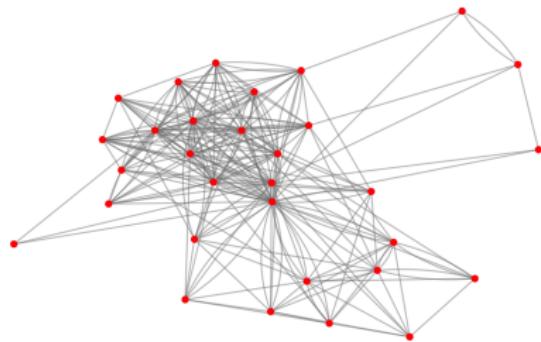


Physicians



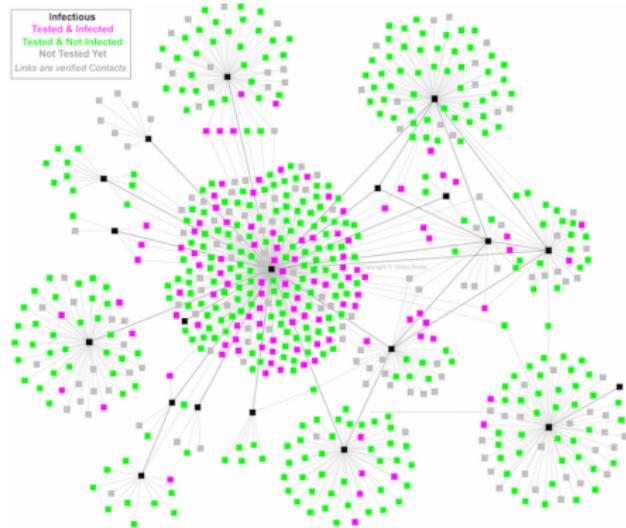
## Social relationships vs. relational data

# Social ties



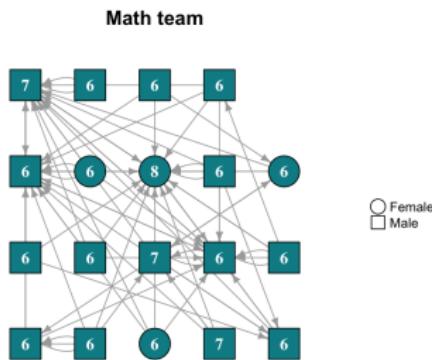
Friendship ties within a class of a Hungarian high school (Vit et al. 2021)

# Social contacts



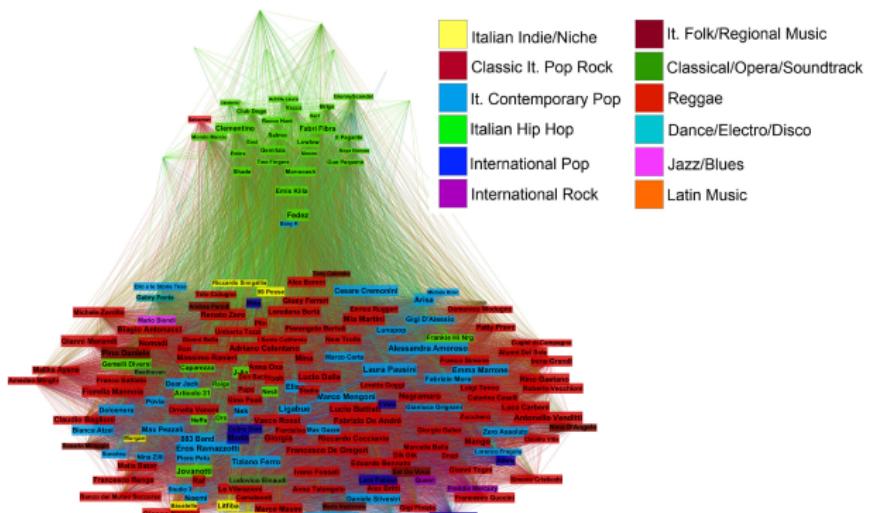
Contacts of a sample of tuberculosis-infected people in Southwest America, 2010 (Andre et al. 2007)

# Social perception



Nominations to represent a classroom (high school in Milan, 2019) in a math competition by gender (De Gioannis, Bianchi, and Squazzoni 2021)

# Social network?



Aioldi (2021)

## Good models for good research

- ▶ Graph theory allows us to represent relationships between objects.
- ▶ In the social sciences we use it to model social relationships between social actors. *Social* networks are models of *social* relationships.
- ▶ Models are neither true or false. They can be more or less useful as representations of what we aim to study.
- ▶ Beware of the assumptions!

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# Schedule

[Link to syllabus](#)

# Assessment

1. Active participation to classes (i.e., engaging in discussions).
2. Final meeting: oral presentation reporting:
  - ▶ simple analysis of network data (provided by me or collected by you) OR
  - ▶ critical analysis of a previously assigned article reporting empirical network research OR
  - ▶ design of an empirical network research related to your own dissertation project

# Background reading

Robins (2015) (Ch. 1-2)

## References I

Airoldi, Massimo. 2021. 'The Techno-Social Reproduction of Taste Boundaries on Digital Platforms: The Case of Music on YouTube.' *Poetics*, 101563.

<https://doi.org/10.1016/j.poetic.2021.101563>.

Andre, McKenzie, Kashef Ijaz, Jon D Tillinghast, Valdis E Krebs, Lois A Diem, Beverly Metchock, Theresa Crisp, and Peter D McElroy. 2007. 'Transmission Network Analysis to Complement Routine Tuberculosis Contact Investigations.' *American Journal of Public Health* 97 (3): 470–77.

<https://doi.org/10.2105/AJPH.2005.071936>.

## References II

- Bianchi, Federico, Niccolò Casnici, and Flaminio Squazzoni. 2018. 'Solidarity as a Byproduct of Professional Collaboration: Social Support and Trust in a Coworking Space.' *Social Networks* 54: 61–72. <https://doi.org/10.1016/j.socnet.2017.12.002>.
- Cousin, Grégoire, Federico Bianchi, and Tommaso Vitale. 2020. 'From Roma Autochthonous Homophily to Socialisation and Community Building in the Parisian Metropolitan Region Shantytowns.' *Journal of Ethnic and Migration Studies*, 1–23. <https://doi.org/10.1080/1369183X.2020.1736993>.
- De Gioannis, Elena, Federico Bianchi, and Flaminio Squazzoni. 2021. 'Gender Stereotypes in the Classroom: Self and Peers' Ability Attribution Among High-School Students in Italy.' *Under Submission*.

## References III

- Robins, Garry. 2015. *Doing Social Network Research. Network-Based Research Design for Social Scientists.* London: Sage.
- Stadtfeld, Christoph, Károly Takács, and András Vörös. 2020. 'The Emergence and Stability of Groups in Social Networks.' *Social Networks* 60: 129–45.  
<https://doi.org/10.1016/j.socnet.2019.10.008>.
- Vit, Eszter, Federico Bianchi, Marco Castellani, and Károly Takács. 2021. 'Do Friends Aspire? Peer Influence and Selection Effects for Academic Achievement and Aspirations.' *Under Submission.*

## References IV

Wang, Peng, Garry Robins, Philippa Pattison, and Emmanuel Lazega. 2016. 'Social Selection Models for Multilevel Networks.' *Social Networks* 44: 346–62.  
<https://doi.org/10.1016/j.socnet.2014.12.003>.