



SOCIAL NETWORK ANALYSIS for DATA SCIENTISTS

today's menu: **Introduction** (LECTURE 01)

Your lecturer: Roger Leenders

Playdate: September 02, 2025

Your instructors



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Getting in touch

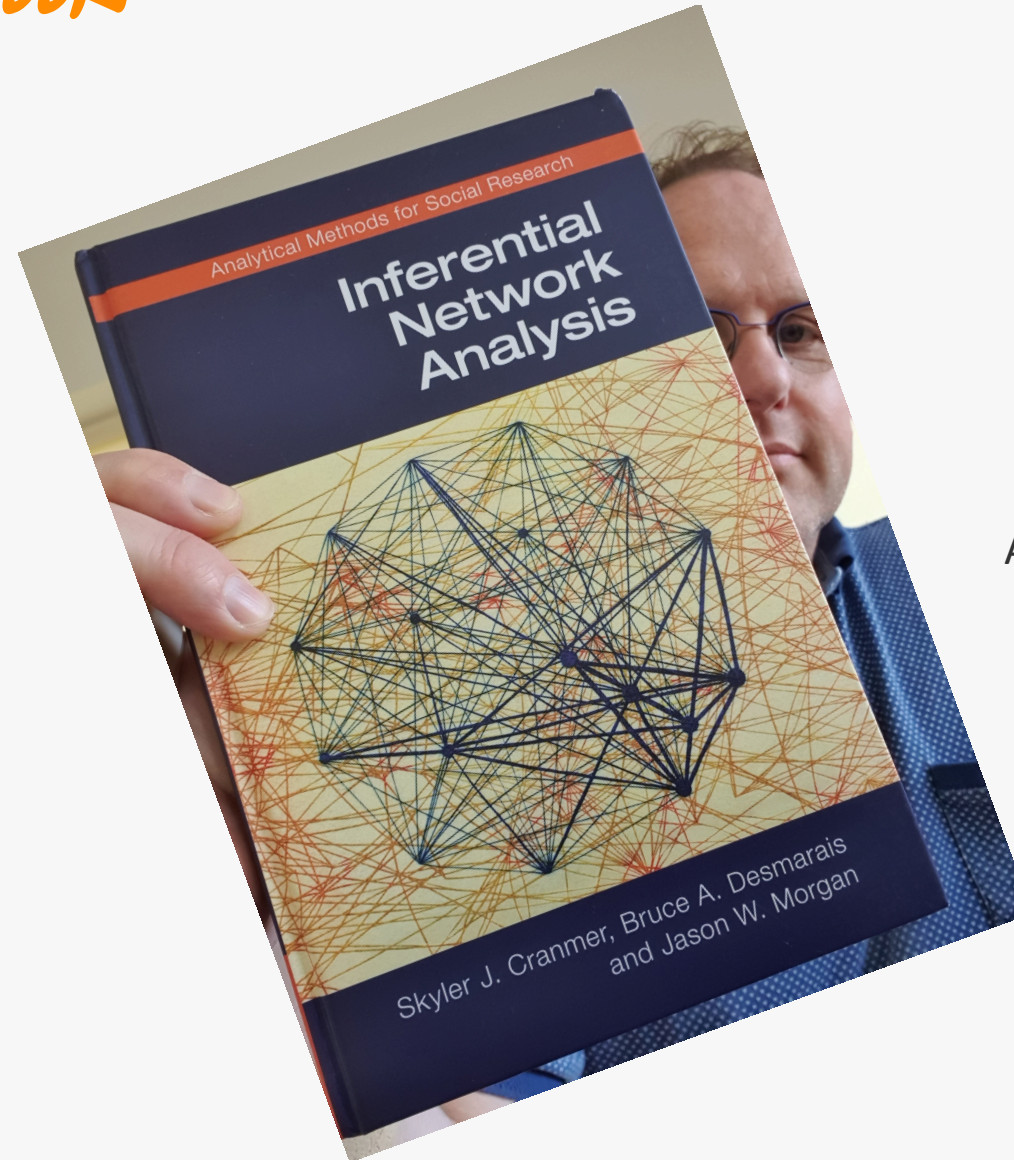


- Speak with us during/around lectures/labs/group meetings
- Speak with us during our office hours
- Get in touch with us through **SNA4DS@jads.nl**

 ***DO NOT email us on our university email addresses***

 ***DO NOT message us through Canvas***

The main book



Additional literature is provided
on Canvas

Complex systems



We are surrounded by systems that are hopelessly complicated.

Consider, for example,

- **communications infrastructures** that integrate billions of cell phones with computers and satellites;
 - our ability to reason and comprehend our world requires the coherent activity of billions of **neurons** in our brain;
 - our biological existence is rooted in seamless interactions between thousands of **genes and metabolites within our cells**;
 - **markets** that revolve around thousands of organizations doing business with each other;
 - **soccer matches** are characterized by 22 actors constantly moving and interacting (passing, giving directions, giving support/criticism) in time and space.
- These systems are collectively called complex systems and can (partly/largely) be understood as **networks**.

The various networks we meet in nature or society vary widely:

- the nodes of the **metabolic network** are tiny molecules and the links are chemical reactions governed by the laws of chemistry and quantum mechanics;
- the nodes of the **WWW** are web documents and the links are URLs guaranteed by computer algorithms;
- the nodes of **social networks** are individuals or groups of individuals, and the links represent family, professional, friendship, and acquaintance ties.

The processes that generated these networks also differ greatly:

- **metabolic** networks were shaped by billions of years of evolution;
- the **WWW** is built on the collective actions of millions of individuals and organizations;
- **social networks** are shaped by social norms whose roots go back thousands of years.

However

a key discovery of network science is that the *architectures* of networks emerging in such varying domains are surprisingly similar to each other, and are governed by *similar organizing principles*.

CONSEQUENTLY, WE CAN USE
A COMMON SET OF
MATHEMATICAL AND
STATISTICAL TOOLS
TO EXPLORE THESE SYSTEMS

How did the field of SOCIAL networks start?



JACOB L. MORENO

May 18, 1889 – May 14, 1974

His 1934 book [Who Shall Survive?](#) contains some of the earliest graphical depictions of social networks.



EMOTIONS MAPPED BY NEW GEOGRAPHY

Charts Seek to Portray the
Psychological Currents of
Human Relationships.

FIRST STUDIES EXHIBITED

Colored Lines Show Likes and
Dislikes of Individuals
and of Groups.

MANY MISFITS REVEALED

Dr. J. L. Moreno Calculates There
Are 10 to 15 Million Isolated
Individuals in Nation.

A new science, named psychological geography, which aims to chart the emotional currents, cross-currents and under-currents of human relationships in a community, was introduced here yesterday at the scientific exhibit of the Medical

"With these charts," Dr. Moreno continued, "we will have the opportunity to grasp the myriad networks of human relations and at the same time view any part or portion of the whole which we may desire to relate or distinguish."

Until we have at least determined the nature of these fundamental structures which form the networks, we are working blindly in a hit-or-miss effort to solve problems which are caused by group attraction, repulsion and indifference."



New York Times
April 3, 1933

An SNA Classic: Windsurfers on the beach



J. Social Biol. Struct. 1988 **11**, 415–425

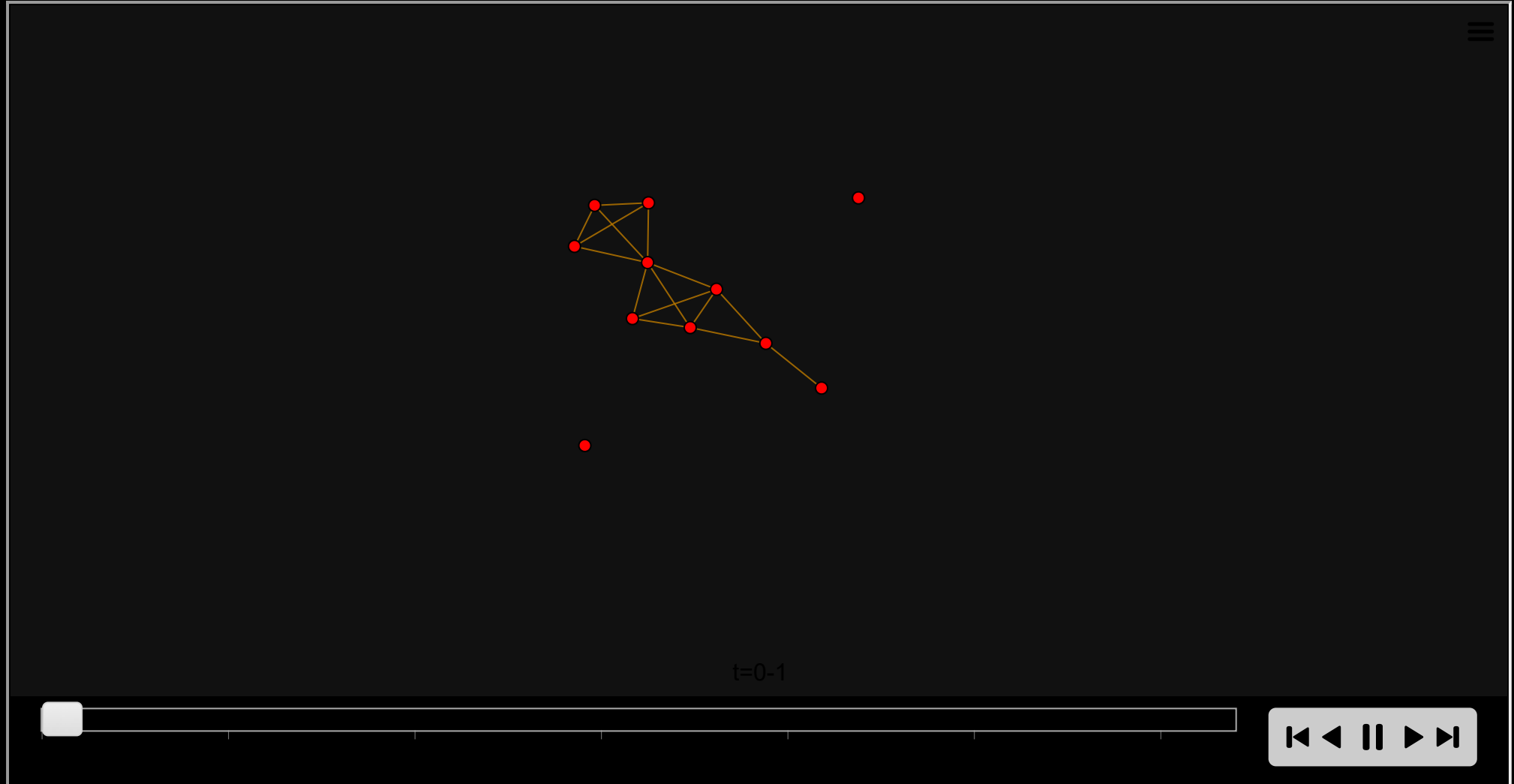
On human social intelligence

Linton C. Freeman, Sue C. Freeman and Alaina G. Michaelson
School of Social Sciences, University of California, Irvine, CA 92651

Arguments for social intelligence in primates require that individuals be able to and recall complex patterns of social relationships among the members of the communities. Indirect evidence suggests that non-human primates possess such abilities. So far, little is known about the extent of human ability to process information about their social relationships. The present results show that, at least with regard to patterns of alliance and division in a community, humans are remarkably accurate in processing such social information.



Windsurfer interactions over time



Formal notation



The most common model of a network in network analysis is that of a *graph*. We will use these terms interchangeably.

A graph consists of

- nodes / actors / vertices
- links / ties / edges / relationships / connections

Formally: $Graph = \{Vertices, Edges\}$

Examples of actors (vertices)

- people
- organizations
- countries
- teams
- animals
- bacteria
- trainstations, airports
- electricity stations
- knowledge repositories
- political parties
- scientific articles
- chapters in a book
- variables in a model
- words
- products
- plants, flowers
- pieces of land
- ...

Examples of relationships (edges)

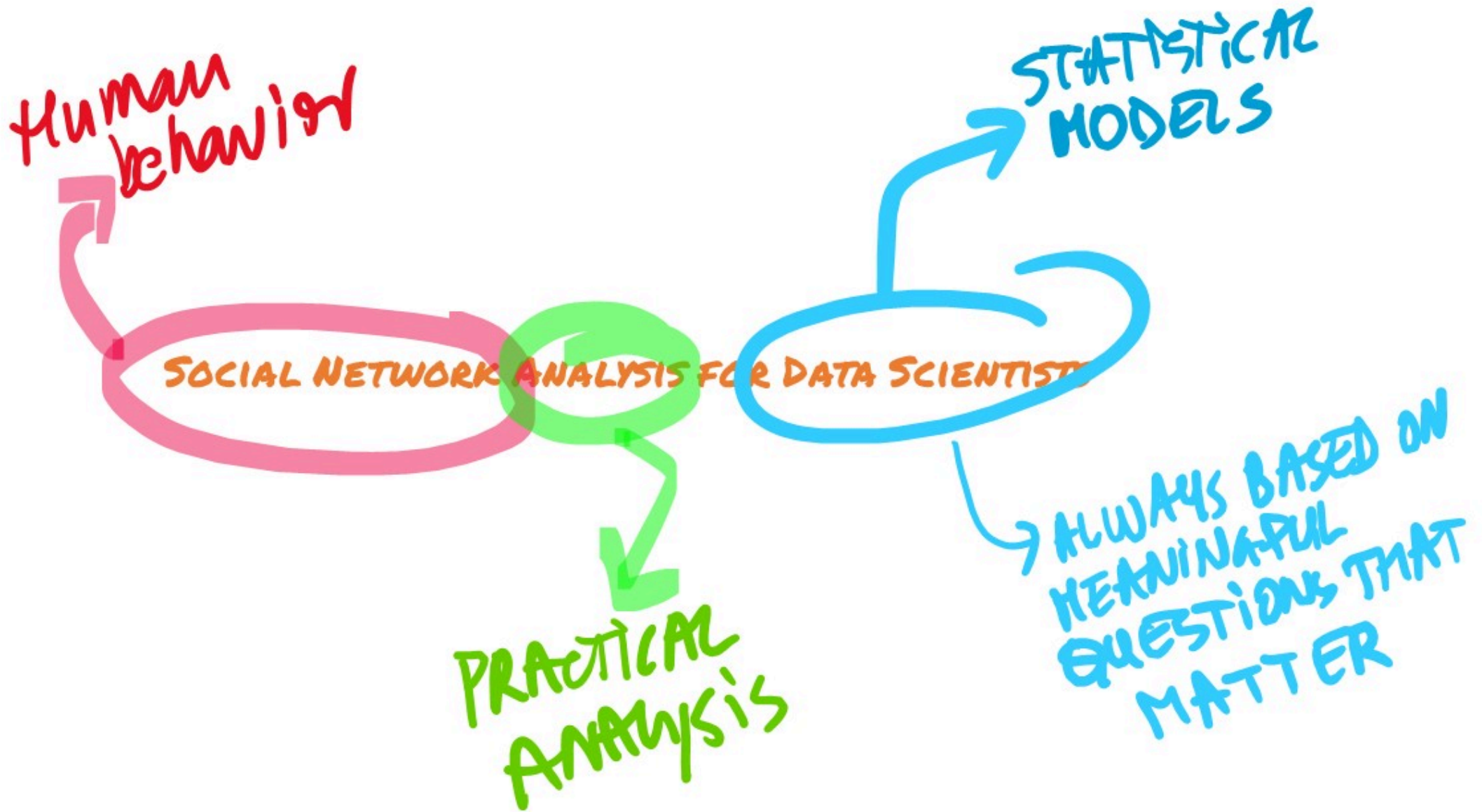
- giving advice
- friendship
- selling a product
- passing on a virus
- voting along
- passing a ball to
- praising
- collaboration
- co-occurrence
- sitting next to
- be in war with
- stealing from
- giving orders
- ...
- ...
- ...

Some examples

- Networks of international diplomacy
- Collaboration between musical artists
- Songs listened to on Spotify
- Terrorist cells
- Drugs trafficking networks
- Users (and bots) on internet forums
- Playing strategy in soccer or basketball
- Book ratings on amazon
- Coffee percolation
- JADS students' social life (eating, drinking, studying)
- Interaction and murder in Game of Thrones
- Migrant movement between countries
- Social movements
- Political debates
- Collaboration in Software development
- Beer rating networks
- Co-authorships between academists

Social Network Analysis for Data Scientists

What is this course about?



Each week



- Labs (mostly on Tuesdays) are online (Zoom)
 - Lectures (mostly on Wednesdays) are in the attic
 - Project progress meetings are at JADS
-
- read the book chapter (or other readings) listed on canvas for that week
 - do the tutorial on the [snaverse](#)
 - do the *homeplay*
 - Come prepared! It will make your life easier and you'll learn so much more :)

Assessment



- Group project (write a report) - 40%
- Exam - 60%

Exam

- Questions and problem sets (with real datasets)
- Similar to the Bootcamp Exam
(but you'll need the full three hours)

Project (I)



With your group, pick a topic related to one of these application fields:

- Political science
- Organizations
- Internet
- Social influence
- Marketing
- Sport
- Text analysis
- Recommender systems
- Crime & Safety
- other (discuss it with Roger or Gergő)

Project (2)



- Identify or collect appropriate and relevant data
- Formulate network-based research questions that can be answered with that data
- Formulate appropriate hypotheses
- Run analyses using the models we will learn in class
- Write a report (about 4500 words)

Details will soon be posted on Canvas, including the intermediate deadlines for the various project milestones.