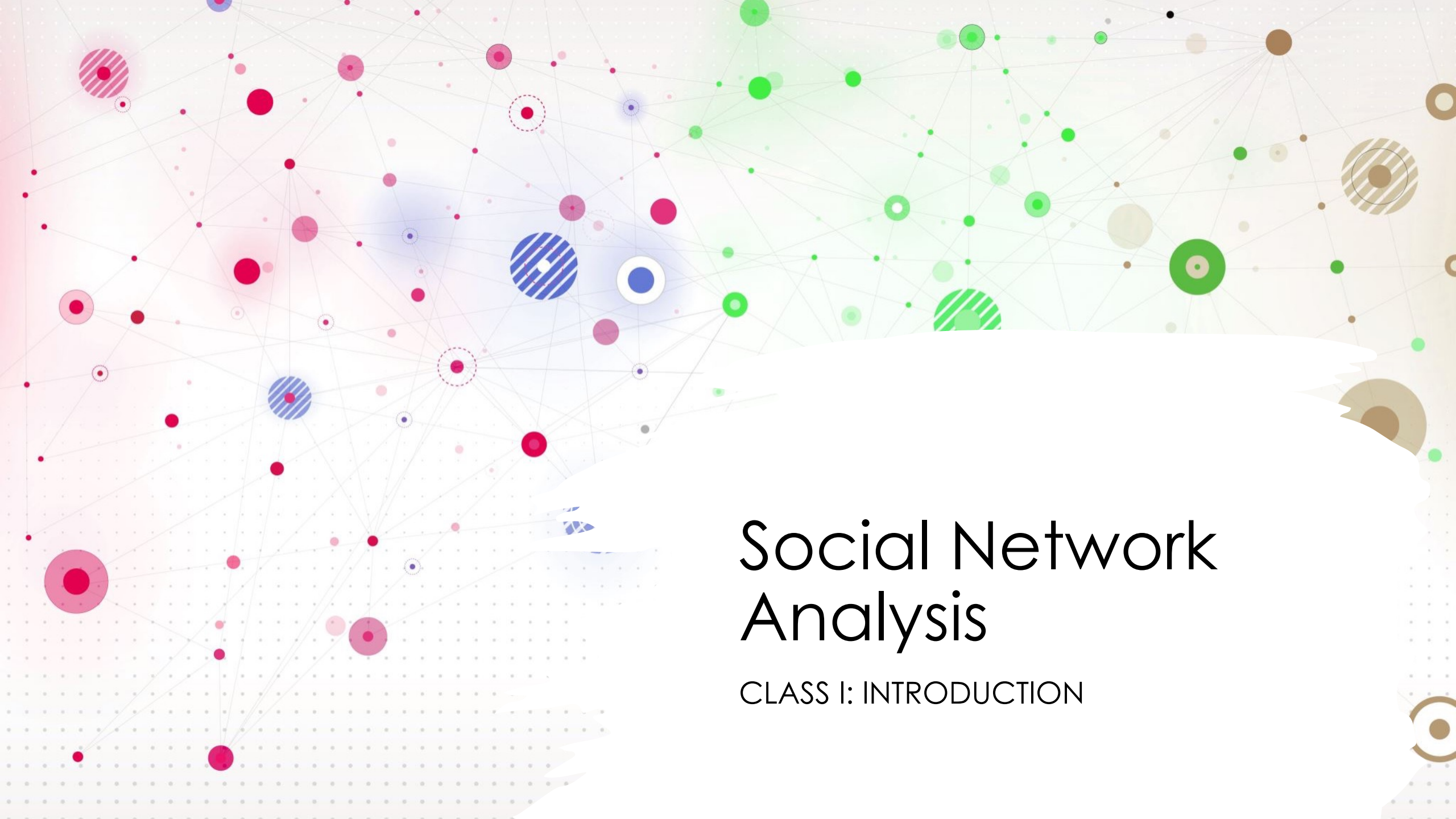


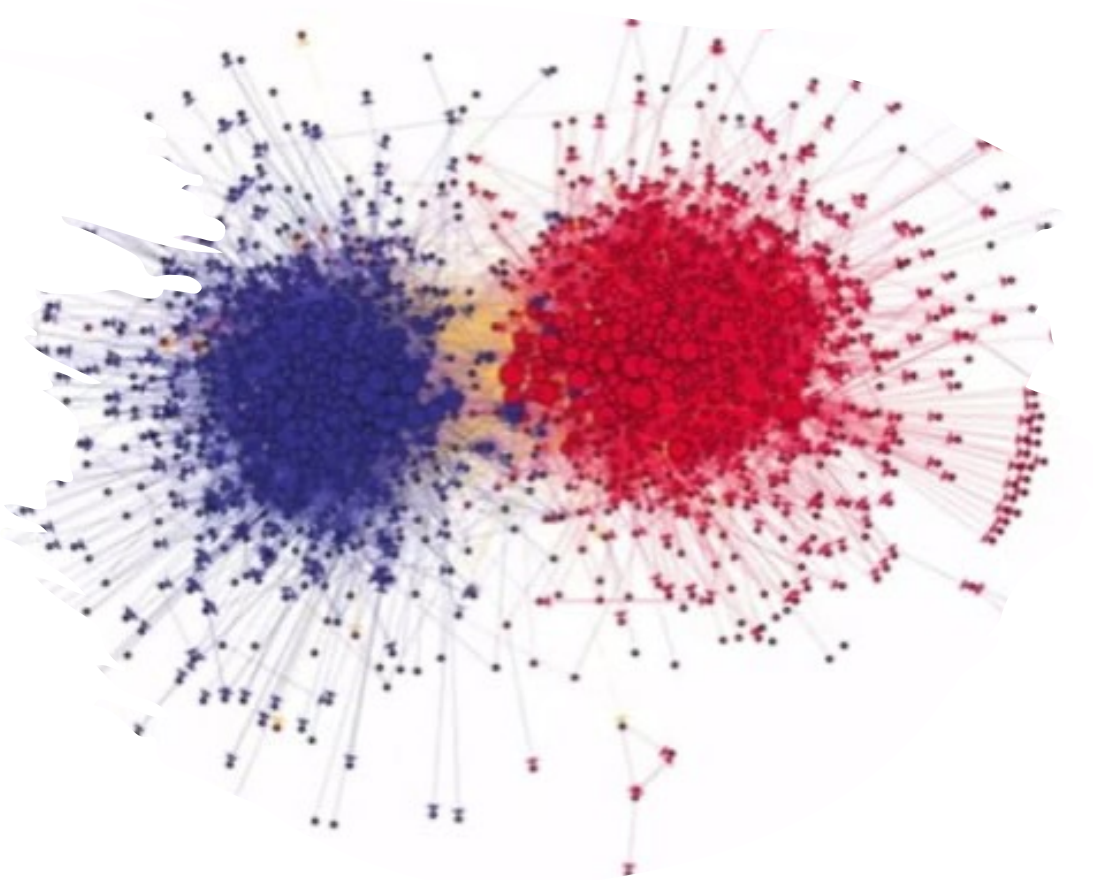
Social Network Analysis

CLASS I: INTRODUCTION

What is this module about?

- Social Network Analysis is a field of methodology that's becoming increasingly important in the social and political sciences.
- At a basic level, it's a set of methods that allow us to study networks – of many different varieties, not just online social networks – and discover insights about the human interactions which those networks represent.

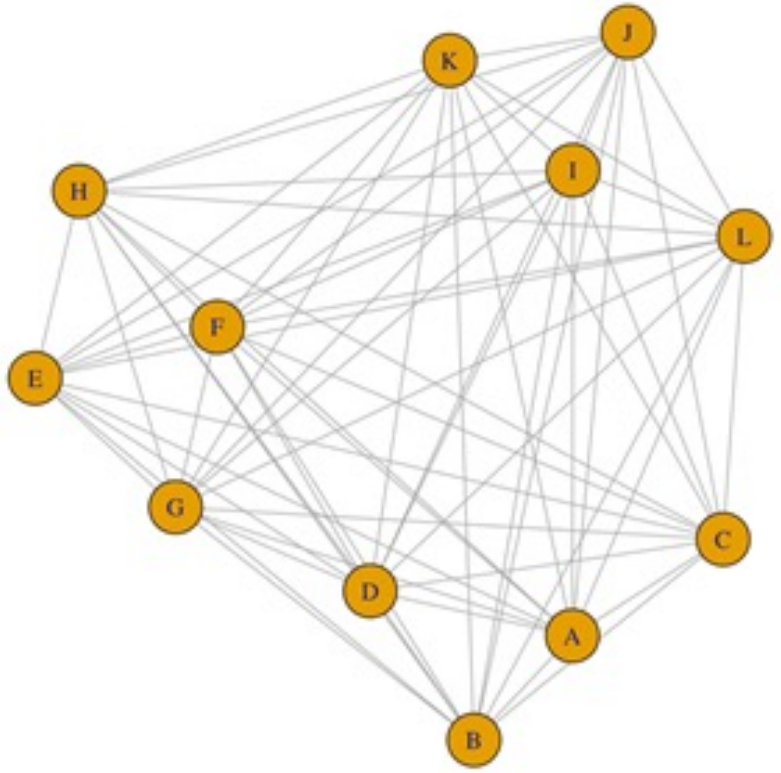
Adamic & Glance 2004



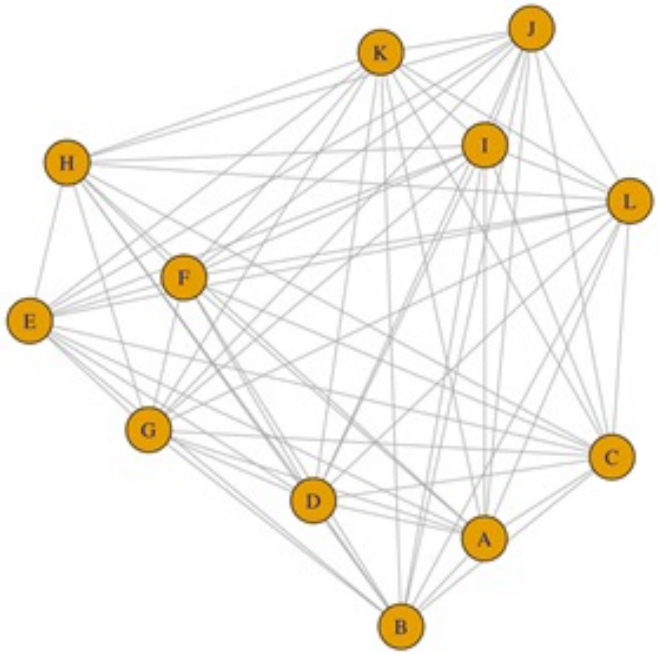
- This network graph, showing the links between Republican- and Democrat-aligned political blog sites in the early 2000s, became very famous.
- It is now seen as an early warning sign of **polarisation** in online political discourse.

What is a Network?

- A **network** is a data structure that is defined by the interactions between the objects being observed.
- It contains two types of information:
  1. Information about the objects being observed;
  2. Information about the interactions between them.



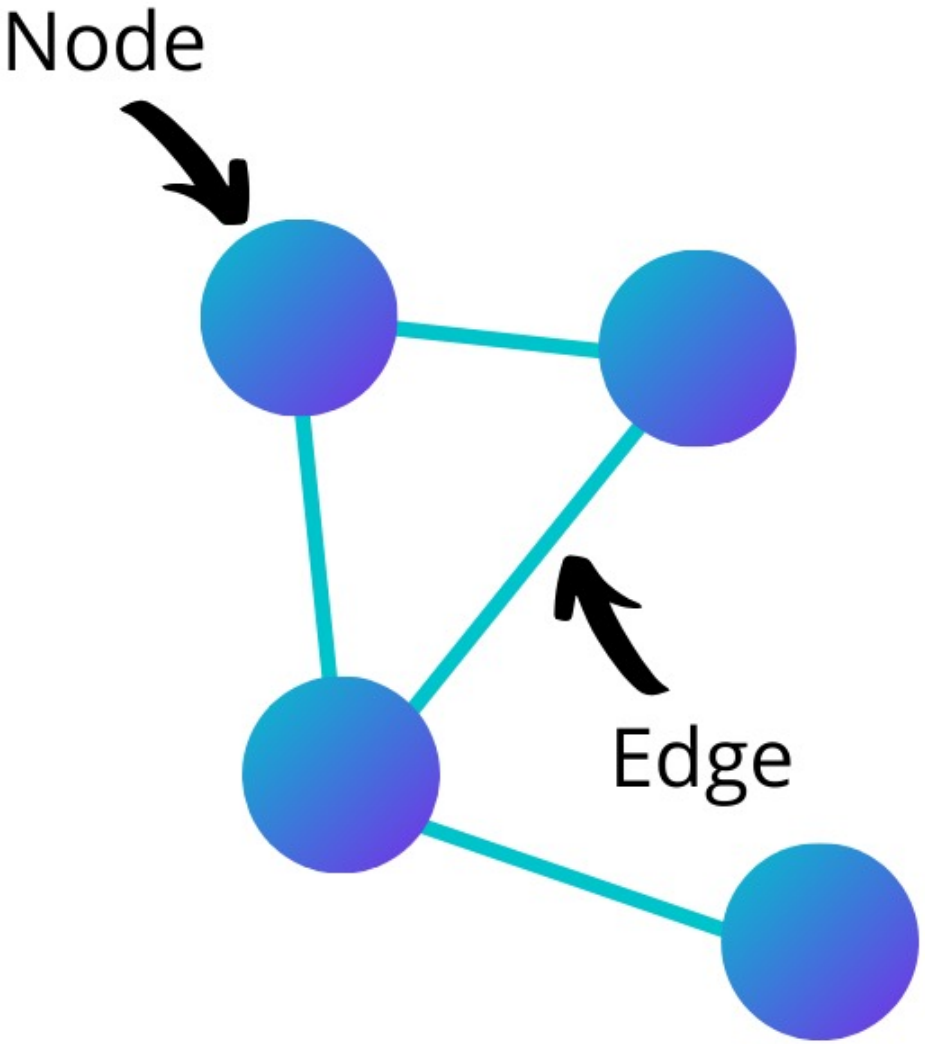
Networks and Graphs



- This kind of data structure is called a **graph**.
- Technically, ”graph” is the abstract, mathematical term for this structure (so you’ll hear mathematicians talk about “graph theory” etc.) – once you create one with actual data in it, it’s a **network**.

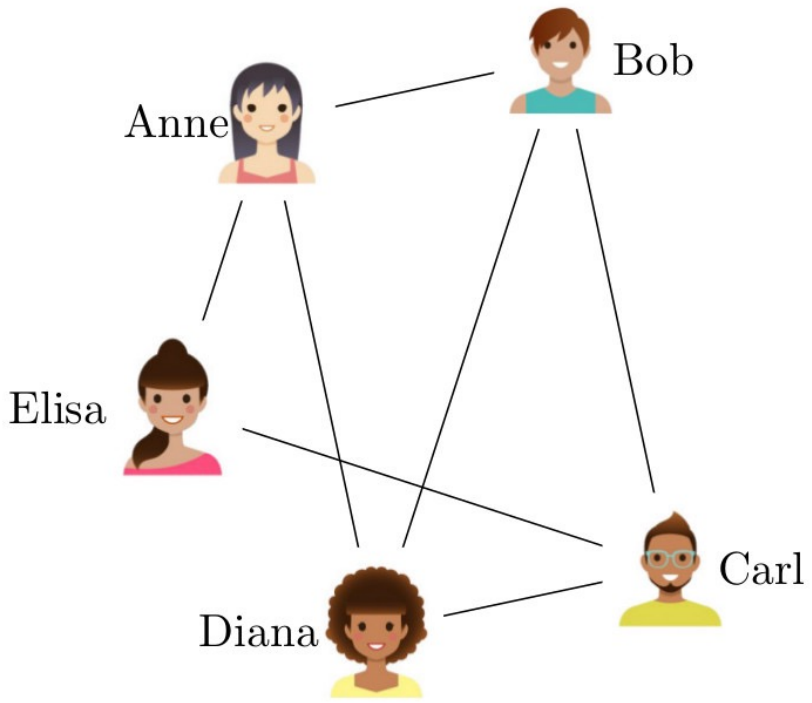
Nodes and Edges

- A quick word on terminology…
- We've been talking about "objects" and "interactions" or "connections", but in network analysis the technical names for these features are **nodes** and **edges**.
- We'll discuss these more later – for now, just remember the terms.



Graph Theory Applications

- Graph Theory – the study of interconnected networks – is used to study many different kinds of networks. For example:
  - Chemists and physicists use graphs to study molecular bonds and quantum fields.
  - Biologists use graphs to analyse genetics and evolution.
  - Computer scientists use graphs to model computer networks and data flows.
  - Mapping applications use graph theory to calculate optimal transport routes.

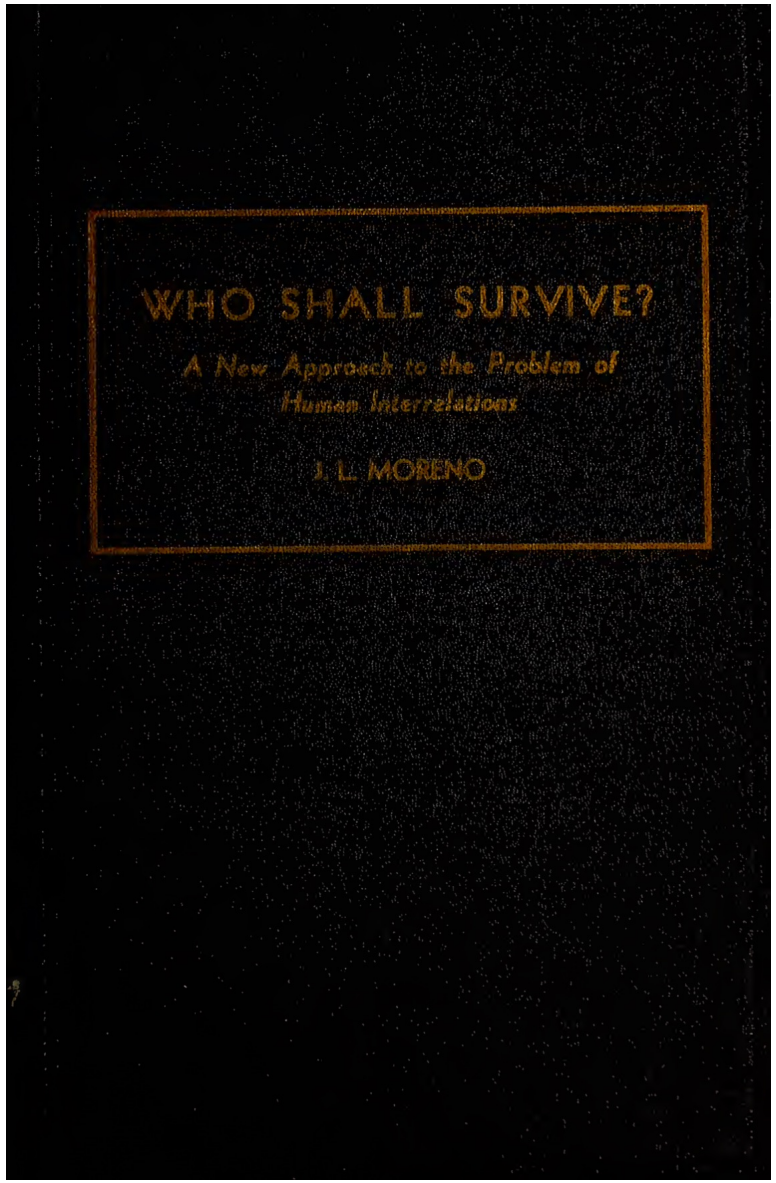


Social Networks

- We're social scientists – we're interested in using graphs to study <u>people</u>.
  - In this case, the **objects** on the graph become individuals (or some representation of them, like an account on a website).
  - The **interactions** could be anything – friendships, encounters, shared interests, financial transactions…

Social Network Analysis: Origins

- When we say “social network analysis”, or even just mention a “social network”, you probably have a mental image of something very modern – at least something from the Internet age.
- You probably don’t imagine the first book on social network analysis being written in 1934!

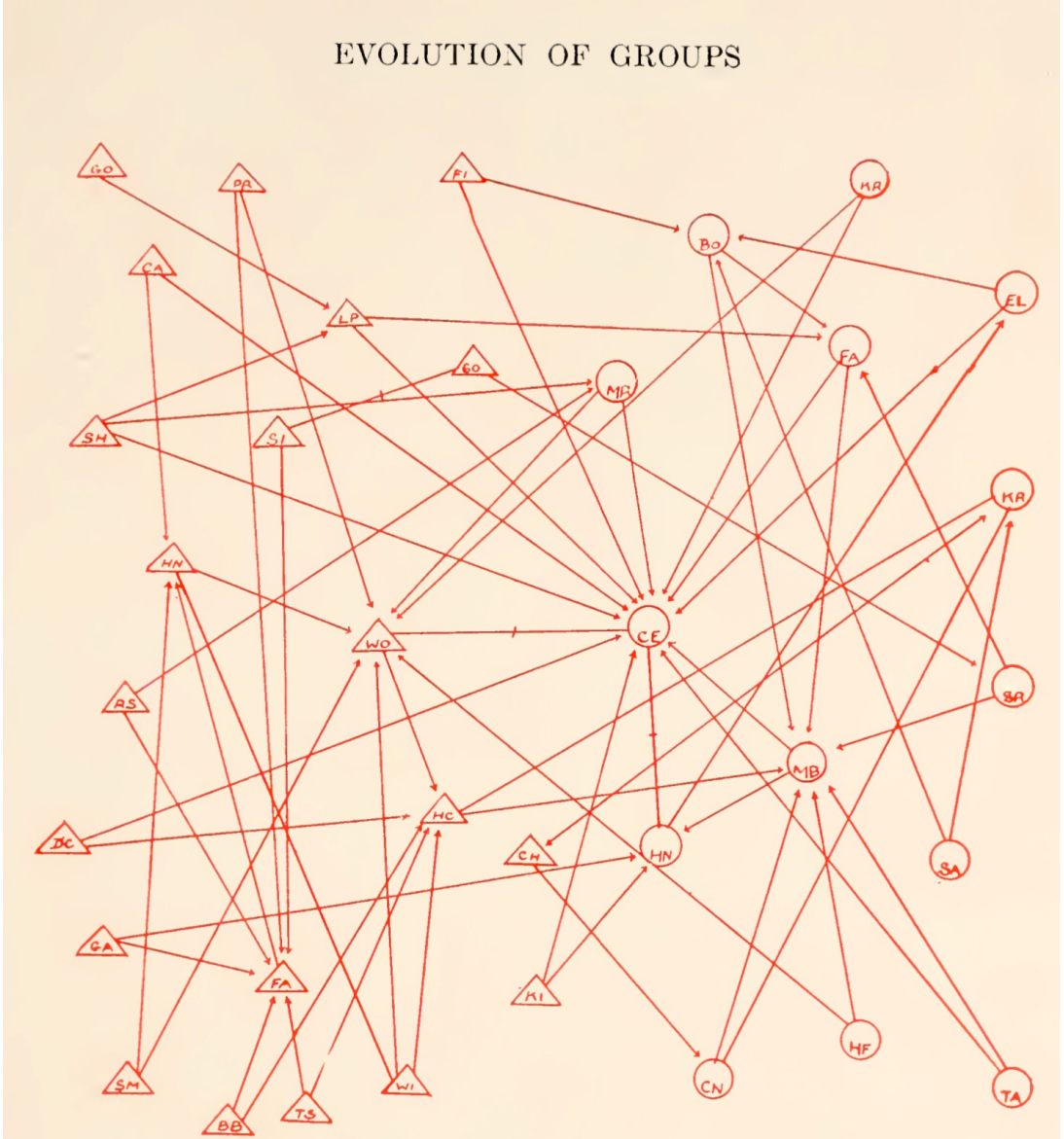


JL Moreno‘s “Who Shall Survive?”

- Jacob Moreno (1889-1974) was a Romanian psychiatrist and sociologist.
- He was interested in studying human psychology in groups – believing that observing group interactions could provide insights that you’d miss if you only considered individuals.

- Working in New York in the 1930s, Moreno devised a series of experiments aiming at understanding group dynamics.
- Observing children in a schoolyard over multiple days, he saw how sub-groups would form.
    - These groups were semi-stable but also dynamic; they formed and re-formed in slightly different configurations on different days.
    - The groups interacted with each other and had different types of internal dynamics.

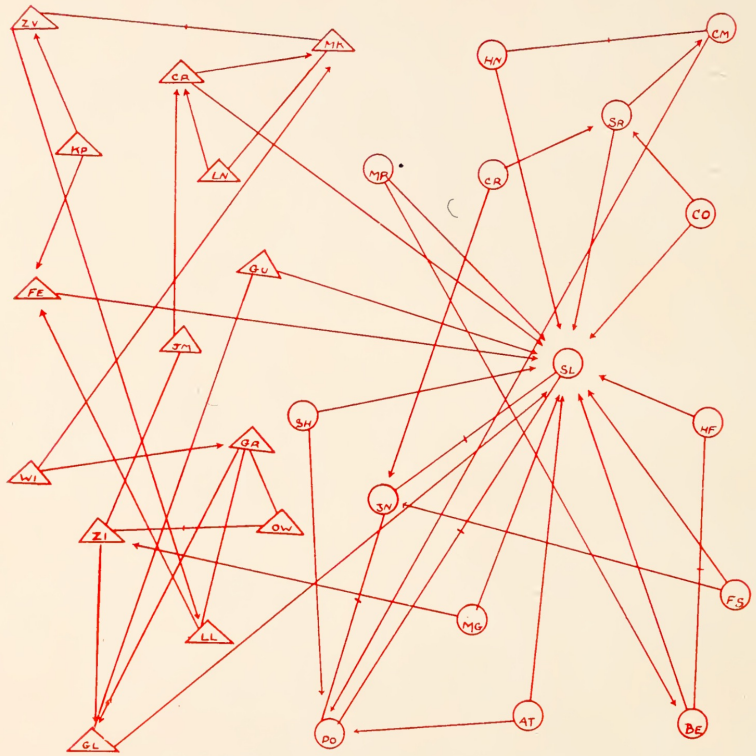
- To better understand these groups, Moreno devised an experiment.
- Each child was asked to (privately) write down the name of the two people they'd like to sit next to in class.
- When Moreno drew a graph of the resulting data, he noticed clear patterns emerging.



CLASS STRUCTURE, 1ST GRADE

21 boys and 14 girls. *Unchosen*, 18, GO, PR, CA, SH, FI, RS, DC, GA, SM, BB, TS, WI, KI, TA, HF, SA, SR, KR; *Pairs*, 3, EI-GO, WO-CE, CE-HN; *Stars*, 5, CE, WO, HC, FA, MB; *Chains*, 0; *Triangles*, 0; *Inter-sexual Attractions*, 22.

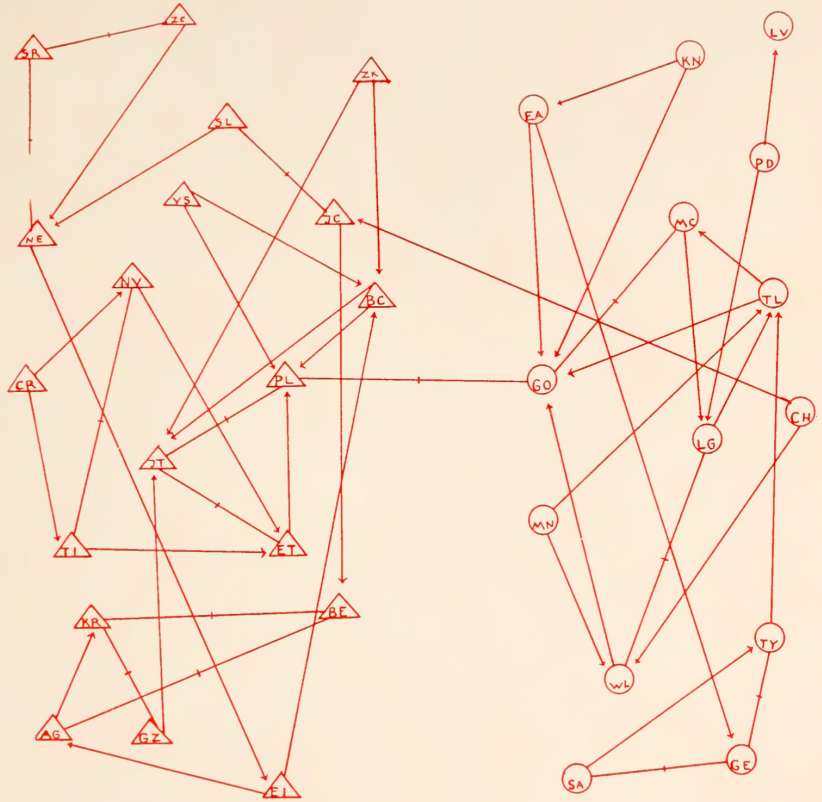
EVOLUTION OF GROUPS



Class Structure, 2nd Grade

14 boys and 14 girls. *Unchosen,* 9, WI, KP, MG, AT, FS, CN, CR, MR, SH; *Pairs,* 11, ZV-MK, MK-LN, OW-ZI, GR-LL, ZI-JM, HN-CM, SL-JN, JN-PO, PO-SL, HF-BE, GL-GU; *Stars,* 2, SL, PO; *Chains,* 0; *Triangles,* 1, SL-JN-PO; *Inter-sexual Attractions,* 5.

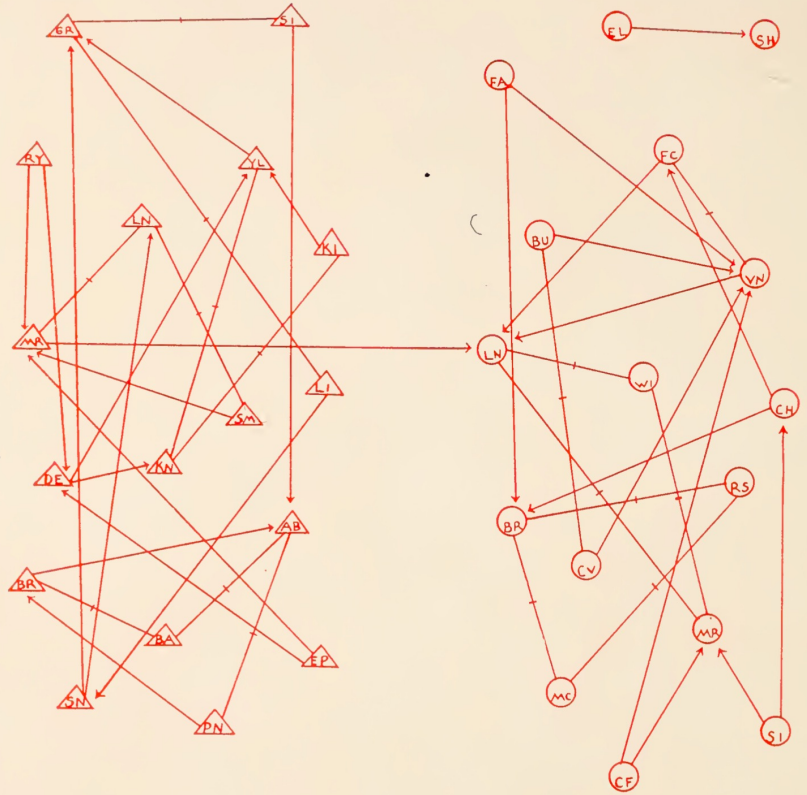
EVOLUTION OF GROUPS



Class Structure, 3rd Grade

19 boys and 14 girls. *Unchosen,* 7, VS, CR, CH, MN, PO, KN, ZK; *Pairs,* 14, SR-ZC, SR-NE, SL-JC, NV-TI, PL-JT, JT-ET, KR-BE, BE-AG, RR-GZ, PL-GO, GO-MC, WL-LG, SA-GE, GE-TY; *Stars,* 3, GO, PL, JT; *Chains,* 1, ET-JT-PL-GO-MC; *Triangles,* 0; *Inter-sexual Attractions,* 3.

EVOLUTION OF GROUPS



Class Structure, 4th Grade

17 boys and 16 girls. *Unchosen,* 6, EP, RY, EL, FA, SI, CF; *Pairs,* 17, GR-SI, GR-LI, MR-LN, LN-SM, YL-KN, AB-BA, BA-BR, KI-KN, AB-PN, FC-VN, BU-CV, LN-WI, LN-MR, BR-MC, BR-RS, WI-MR, MC-RS; *Stars,* 2, LN, VN; *Chains,* 0; *Triangles,* 2, BR-RS-MC; LN-WI-MR; *Inter-sexual Attractions,* 1.

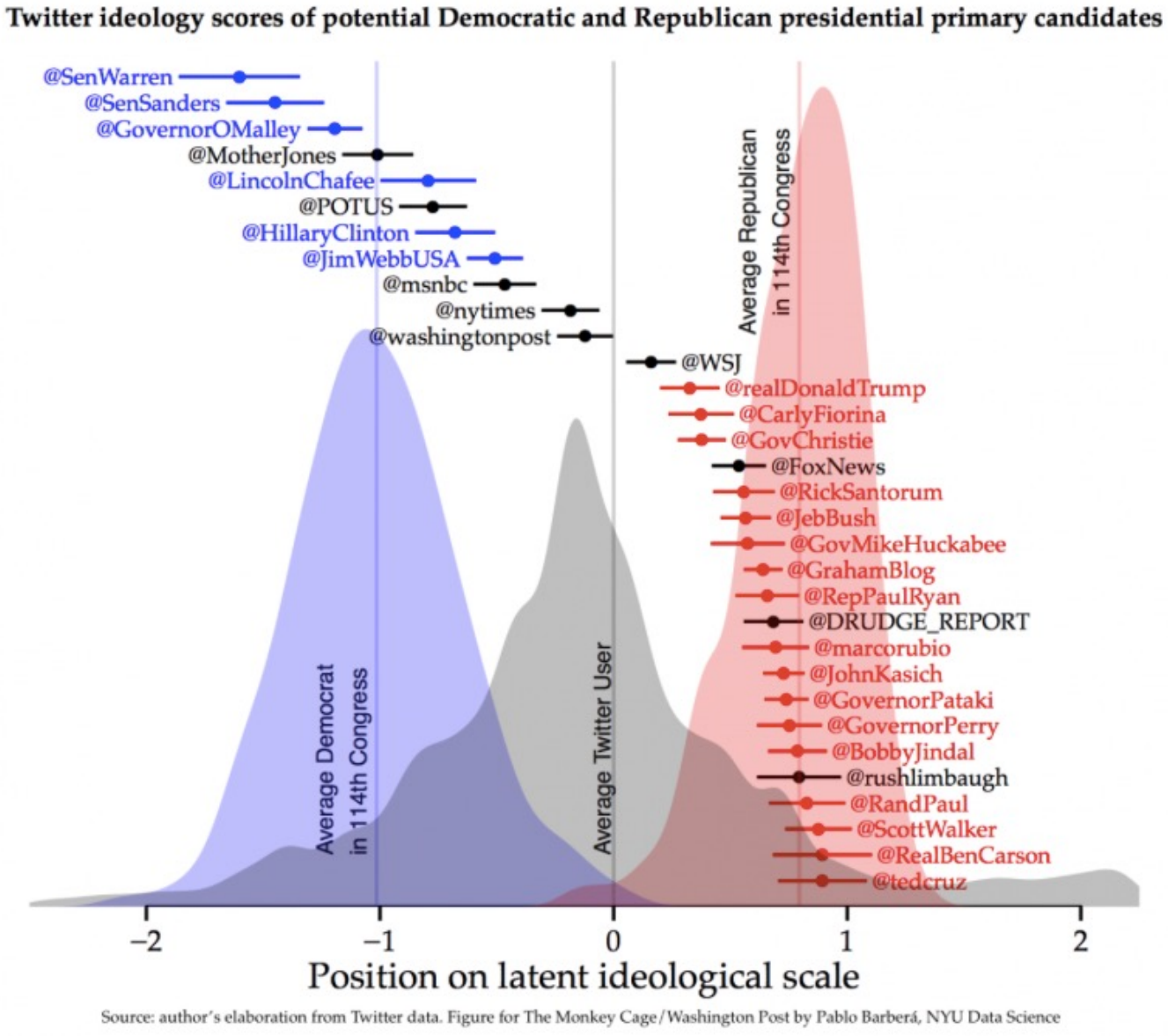
- Moreno's studies of the schoolchildren (which he also repeated in other settings with adults) had uncovered something vitally important.
- Analysing their community as a network allowed him to see very different roles played by different people.
- The shape and pattern of the network – known as its **topography** – could be interpreted in order to understand the community not merely as a collection of individuals, but as a dynamic social system.

Online and Offline Social Networks

- Of course, 86 years later, our use of the word "social network" has evolved; it now commonly refers to sites like **Facebook**, **Twitter** and **Instagram**.
- In social science, the definition remains broader – those services **are** social networks, but so is a town, a classroom, a parliament, or any other group of human beings interacting.

Barberá 2015

- This may not look like a network – but it's based on network analysis techniques.
- Barberá used the overlap between politicians' followers on social media to calculate the distances between them in a network.



Examples of Networks

- In fact, this very broad definition helps to show why network analysis has become so important – because a great many things in the world are best explained through the study of **interactions**.
- Let's take a look at a few relevant examples of data around us that could be effectively represented and analysed as a network.

Small Groups

- **Parliaments**

  Edges: interactions between politicians (participation in events, co-sponsoring bills, etc.)

- **Companies / Organisations**

  Edges: emails between individuals; participation in meetings or projects

- **Local Communities**

  Edges: physical interactions; shared memberships of clubs or organisations; family relationships.

Large Groups

- **Online Communities**

  Edges: shares / retweets; follow / follower relationships; mutual following of third parties

- **Large Towns or Cities**

  Edges: living / working in the same districts; shared attendance at major events (sports etc.) or shared habits (drinking in the same bars)

- **Transport Networks**

  Edges: Passenger movements through the network

Academic Literature

- Academic / scientific literature can be modelled as a network in two key ways:
  - Use citations as edges – linking publications / papers according to the research they cite, and are cited by.
  - Use co-authoring as edges – linking researchers according to the people they have collaborated with.

(Mis)information Flows

- The flow of information through a community can be traced by modelling how it propagated through a network.
- For example, by constructing a network from Twitter data, we could trace back misinformation / propaganda stories to see:
  - which accounts created the information initially;
  - which accounts were responsible for spreading it into new communities.

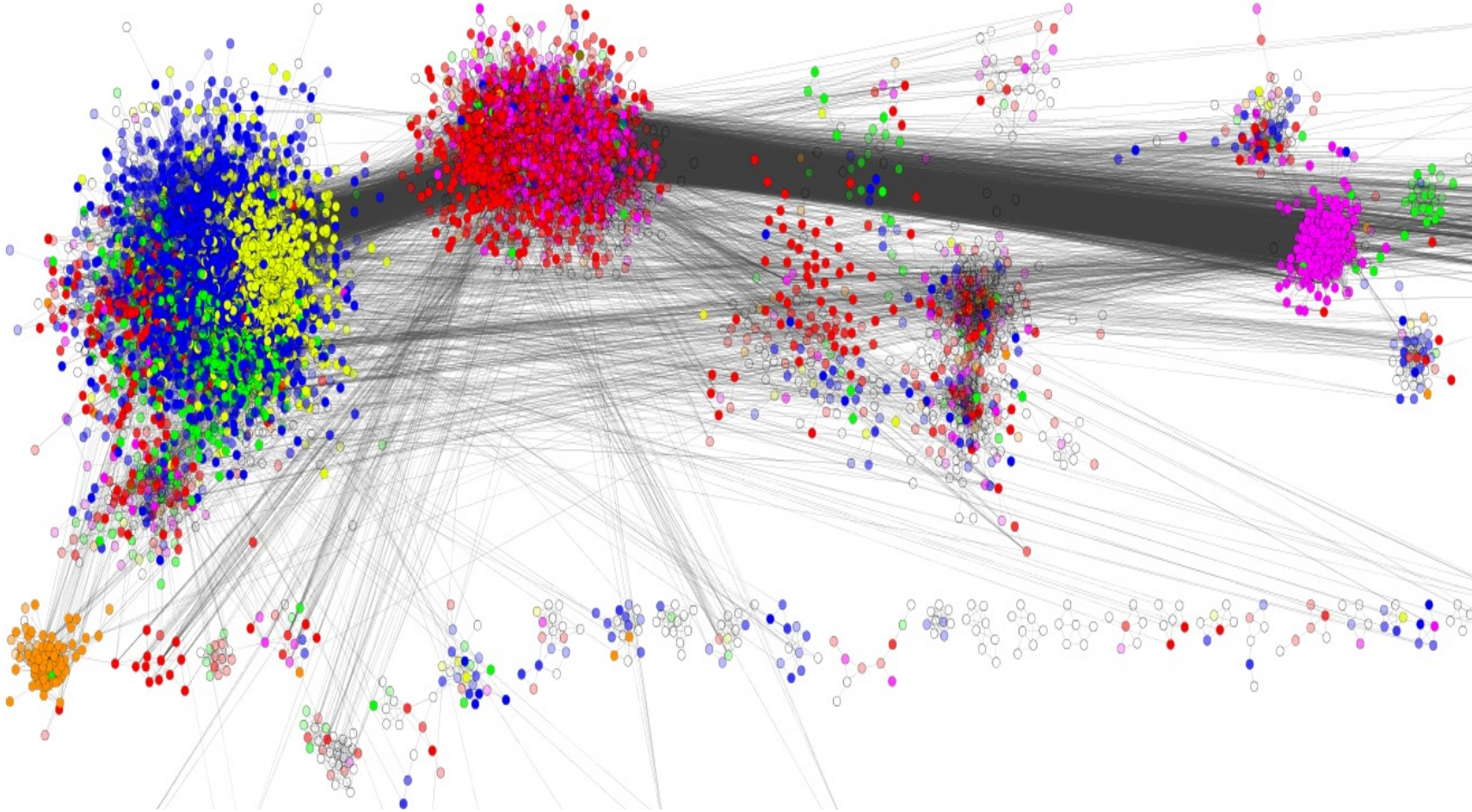
International Relations

- Trade flows between countries and regions can be represented and analysed as networks.

- Similarly, network analysis can help to clarify the complex web of security treaties and relationships which bind many of the world's countries together.

Fahey 2018

- A “home-grown” one, this time…
- This network shows the similarity between Japanese Twitter users, colour-coded by their political alignment.



Objectives of this Module

- Our objective by the end of the module is to be able to:
  - Download network data from an online social network;
  - Turn that data into a network in R;
  - Analyse that network to discover what sub-groups or communities it contains, or how information spreads over it;
  - Visualise that network with a publication-quality image which shows the results of our analysis.

But first…. Small steps.

- Online social networks are **big and complex**.
- Before we start working with that kind of data, we need to practice with smaller-scale networks.
- This is also useful for seeing how you might apply social network analysis to things other than online networks!
  - Lots of really good social science work has been done using network theory to study international relations, relationships between politicians and lobbyists, political donations…

Course Structure

	Week One	Week Two
Monday	Introduction Lecture	Building Networks from Twitter Data
Tuesday	Network Analysis Overview (*)	Analysing Twitter Networks
Wednesday	Creating Networks in R	Combining Text and Network Analysis (*)
Thursday	Simple Analysis and Visualisation	Visualising Large-Scale Networks
Friday	More Advanced Analysis (*)	Students' Research Presentations

(*) – These classes are scheduled as on-demand lectures.

Assessment

- There will be an assignment for this course every day. It won't usually be long or complex – but you will have something to submit every single day.
  - These assignments will make up 60% of your grade.
- In addition, there will be a longer assignment – a small research project you will design and undertake. You will make a research presentation in the last class and then write up a short paper about your project; overall this will make up 40% of your grade.

Today's Assignment

- For your first assignment, I want you to think about your own research field – this can be the field you're working on for your final thesis or just the field you're most interested in.
- What are some networks that exist and could be analysed in that field?
  - Don't just say "Twitter" –write briefly about the actual actors (i.e. nodes) you're interested in (politicians? Activists? Media outlets?) and how their interactions could be turned into a network.

Assignment Details

- Full details of each class' assignment will be posted on my website each day – www.robfahey.net

- The slides and any class materials (R scripts, data files etc.) for each class will also be available there.