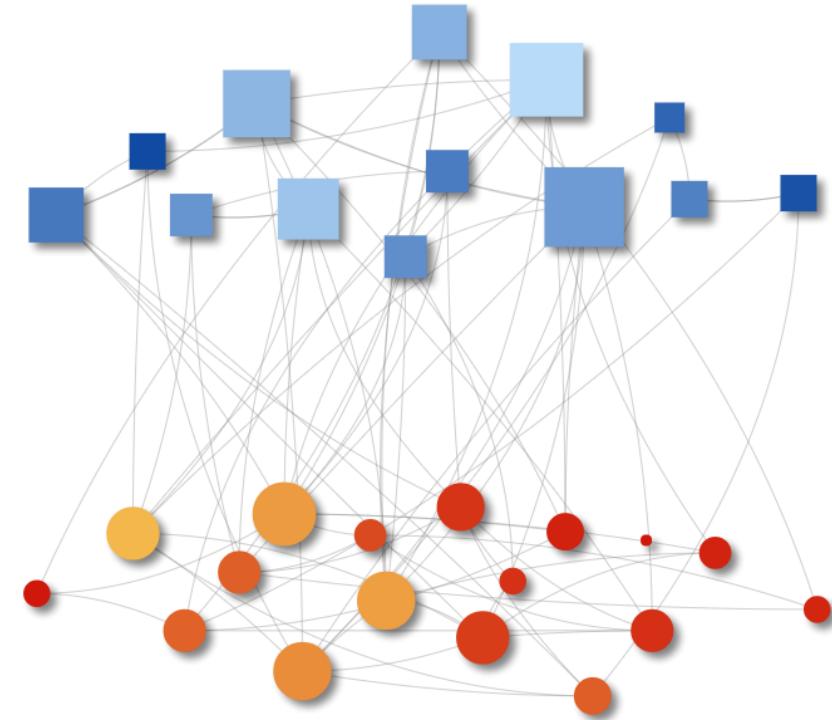


COS60011 Technology Innovation Project

Data Analytics

Peng Wang



Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.



Course Outline

WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
Introduction to unit	Problem identification	Research of project learning issues	Innovation Concept	Design and Development	Design and Development
<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Introduction to Project Workshop 2: Innovation & Research <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Introduction to Unit Seminar 2: Innovation & Research 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Problem identification Workshop 2: Conducting a literature review <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Conducting a literature review 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Research of project learning issues Workshop 2: Applying literature to an innovation project <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Applying literature to an innovation project 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Innovation Concept/research report Workshop 2: Professional writing <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Professional writing 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Design and Development Workshop 2: Professional communication <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Professional communication 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Design and Development Workshop 2: Communicate a design process <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Communicate a design process
		 Team Agreement		 Research report							
WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12
Modelling and simulation or building	Modelling and simulation or building	Prototyping & testing	Testing & evaluation, client feedback	Client & panel presentation	Product delivery/reporting
<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Modelling and simulation or building Workshop 2: Communicating a design solution <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Communicating a design solution 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Modelling and simulation or building Workshop 2: Reflection & reflective practice <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Reflection & reflective practice 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Prototyping & testing Workshop 2: Academic integrity & plagiarism <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Academic integrity & plagiarism 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Testing & evaluation, client feedback Workshop 2: Professional ethics <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Professional ethics 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Client & panel presentation Workshop 2: Legal & other professional issues <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: Legal & other professional issues 	<p>OC</p> <ul style="list-style-type: none"> Workshop 1: Product delivery/reporting Workshop 2: professional skills summary <p>OL</p> <ul style="list-style-type: none"> Seminar 1: Discipline-based seminar Seminar 2: professional skills summary
 Innovation concept				 Project presentation  Design Demonstration	 Peer Assessment report  Project final report

Assessments

Assignment 1: Individual Research Report (20%) Friday, 18th August, 11:59pm

Assignment 2: Team Innovation Concept (25%) Friday, 8th September, 11:59pm

Assignment 3: Project Demonstration and Presentation (25%) Friday, 20th Oct.

Assignment 4: Project Final Report (25%) / Peer Assessment (5%) Monday 30th Oct.

Workshop Topics

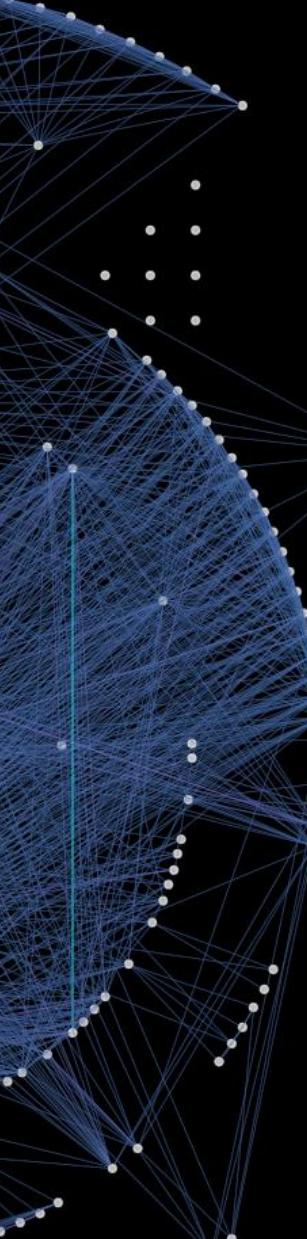
Project

- Social network analysis
- Network data and network samples
- Descriptive statistics for network data
- Exponential Random Graph Models (ERGM)
 - Logistic regression
 - Simulation
 - Estimation
 - Goodness of fit
- Reporting ERGM findings

Technology

- Cross-platform/Web application
- Data visualisation
- Object oriented programming
- Parallel programming
- Interactive Report

Social Network Analysis



'Consider two variations of a situation with which we are all familiar – the high school exam.

In one version, the rules are as we expect them to be. The students must sit in silence, must not communicate with anybody and cannot even glance sideways.

In another version, the teenagers are welcome to communicate with their classmates, are encouraged to walk around and compare notes, and those who excel in the topic are placed among weaker groups and rewarded for sharing their knowledge.

The results for those in the latter scenario would, of course, be far higher as a group than those in the traditional situation.'



Professor Garry Robins

ANALYTICS

Better People Analytics

by Paul Leonard and Noshir Contractor

FROM THE NOVEMBER-DECEMBER 2018 ISSUE

Relational Analytics

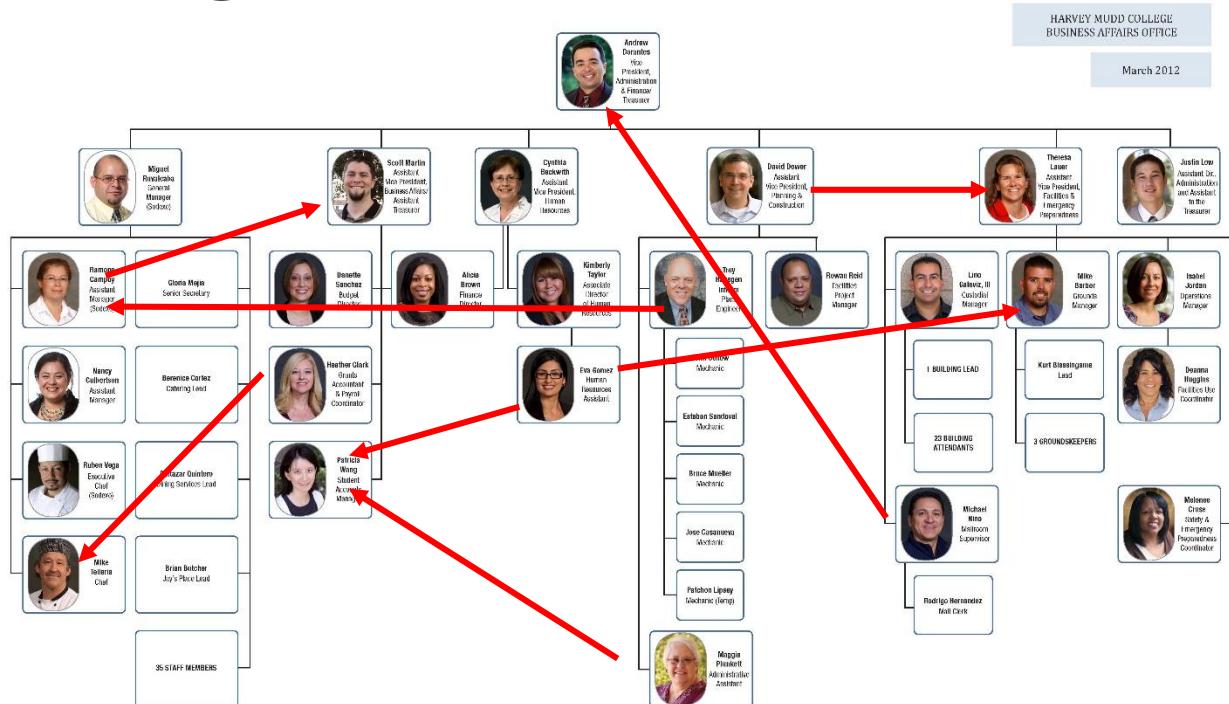
[SUMMARY](#) [SAVE](#) [SHARE](#) [COMMENT](#) ⁷ [TEXT SIZE](#) [PRINT](#) [\\$8.95 BUY COPIES](#)

“**W**e have charts and graphs to back us up. So f*** off.” New hires in Google’s people analytics department began receiving a laptop sticker with that slogan a few years ago, when the group probably felt it needed to defend its work. Back then people analytics—using statistical insights from employee data to make talent management decisions—was still a provocative idea with plenty of skeptics who feared it might lead companies to reduce individuals to numbers. HR collected data on workers, but the notion that it could be actively mined to understand and manage them was novel—and suspect.



Every organisation has one of these.....

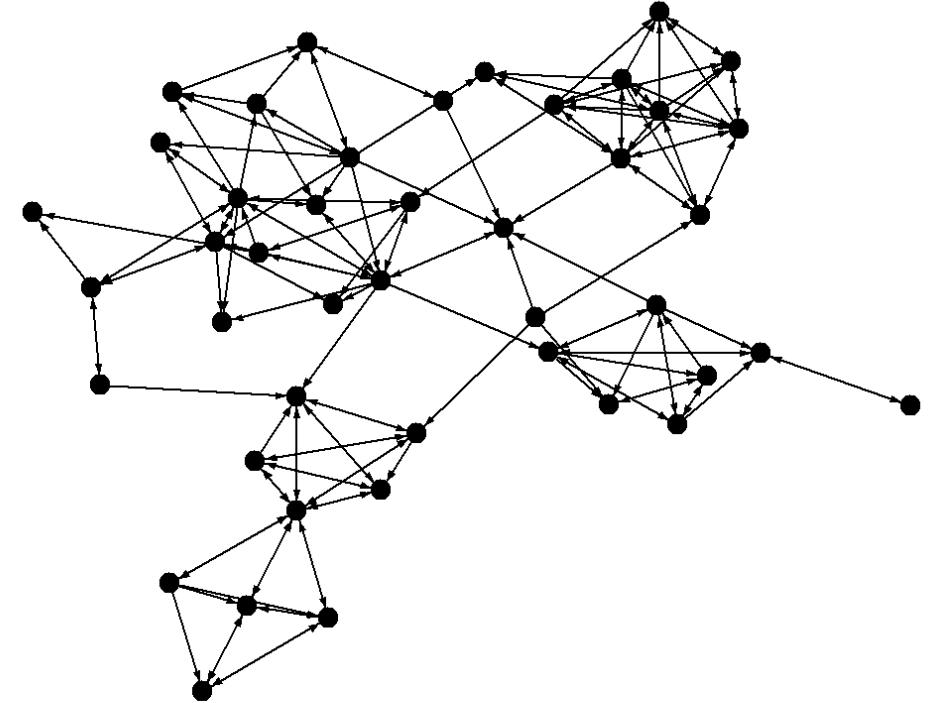
Organisational Chart



How work is *formally* structured

and also one of these

Network

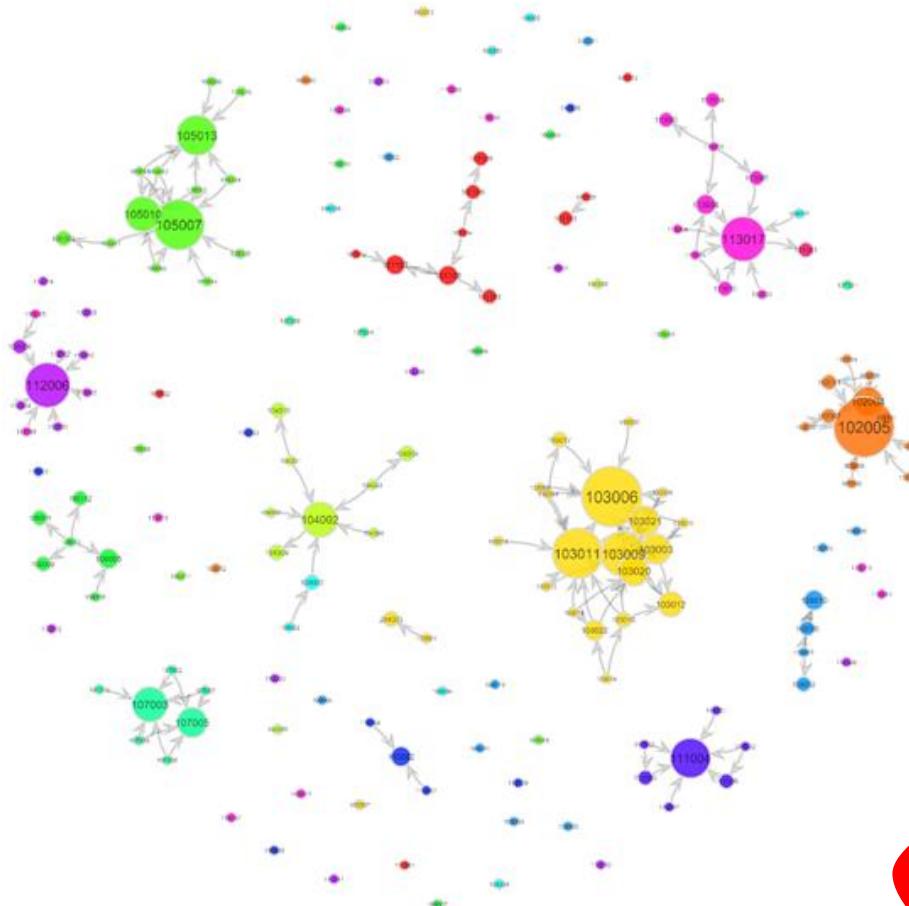


How work is *informally* done

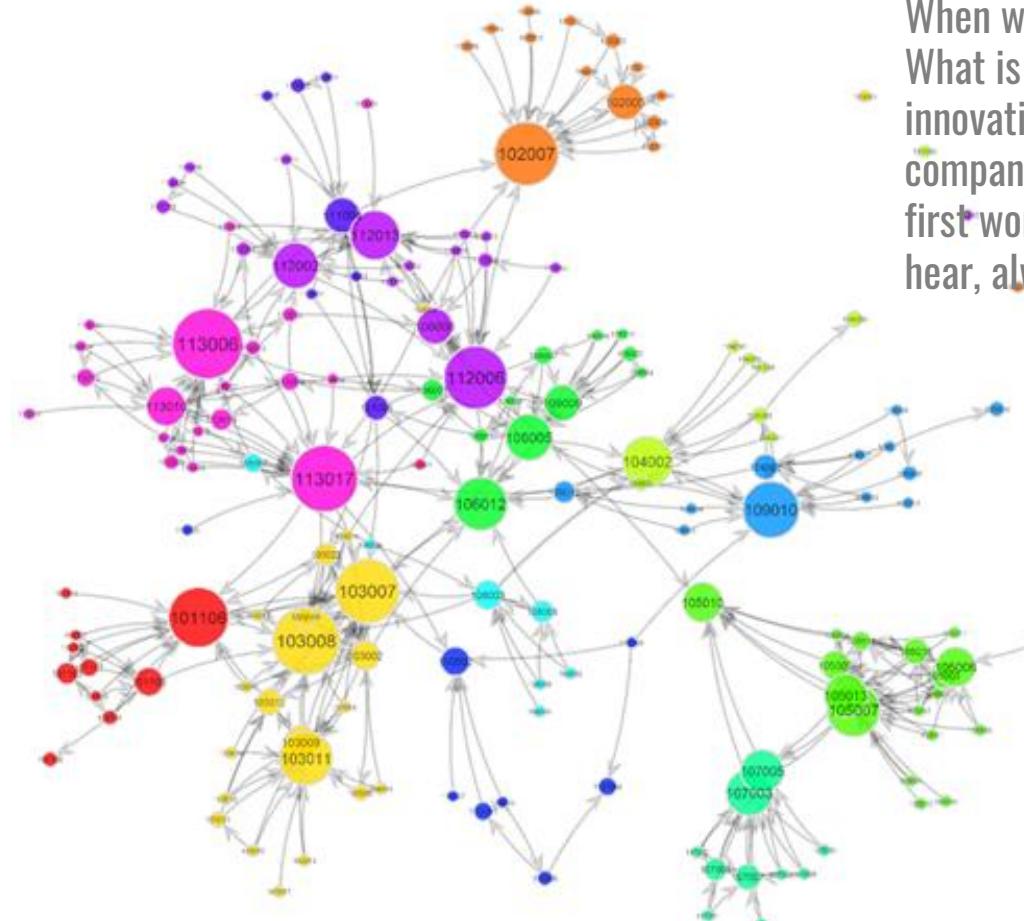
How do formal structures and informal networks work together?

Silo identification

How connected is your organisation?



No communication between units



Inter-unit connectivity

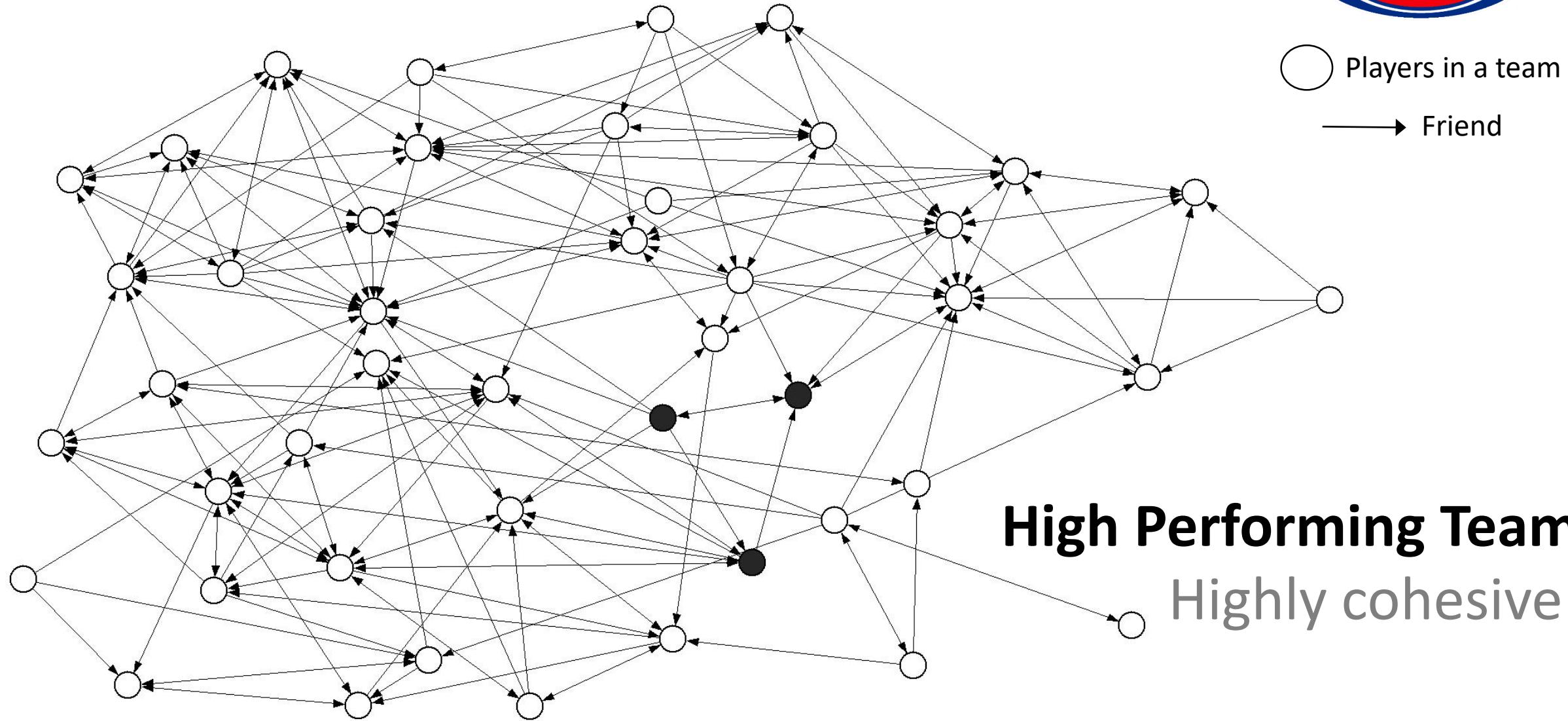


Harvard Business Review

When we ask executives, What is the number one innovation killer at your company?, one of the first words we always hear, always, is “silos!”

Cohesion

'Trust'



High Performing Team

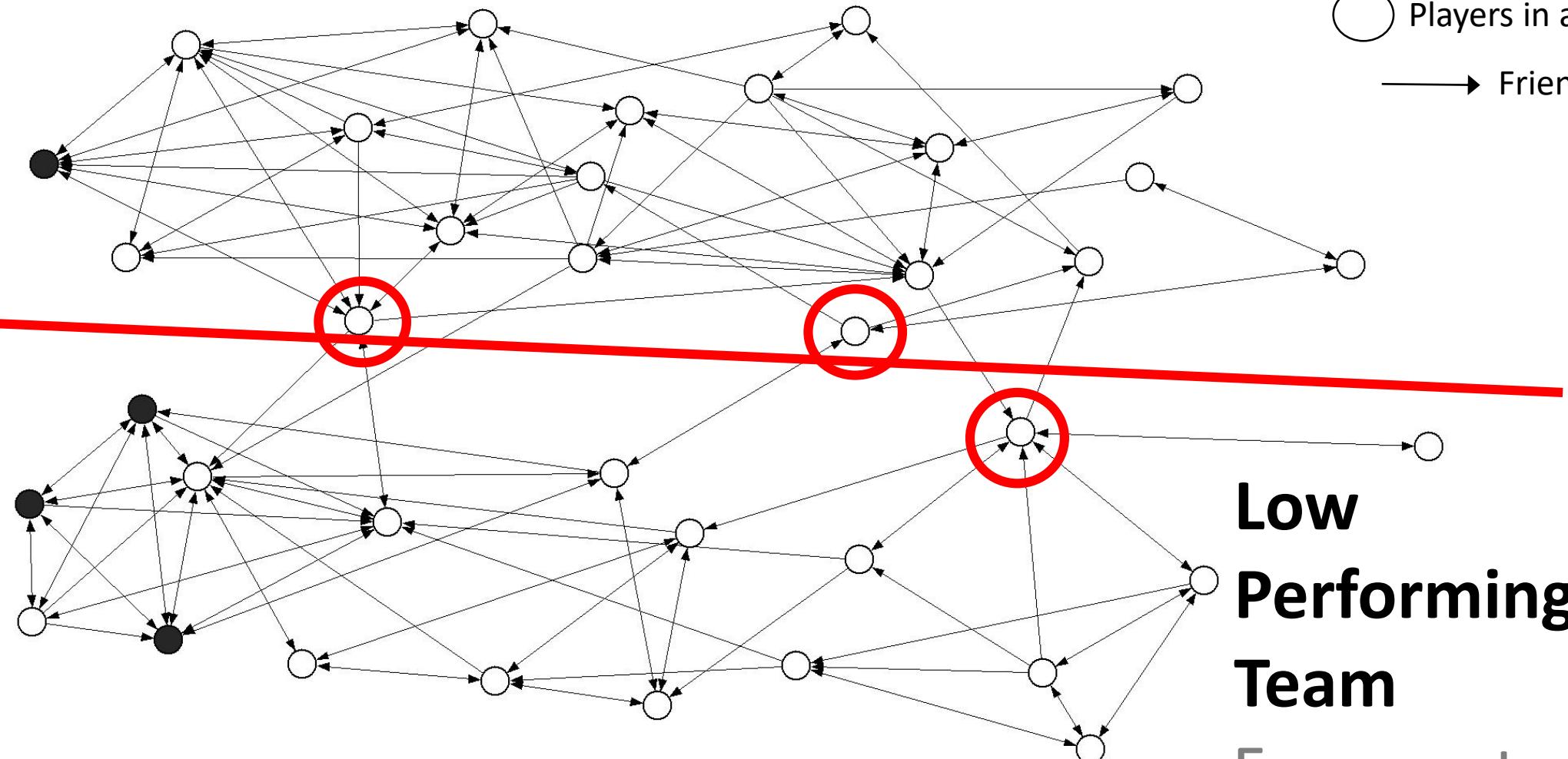
Highly cohesive

Critical Connectors

'Trust'



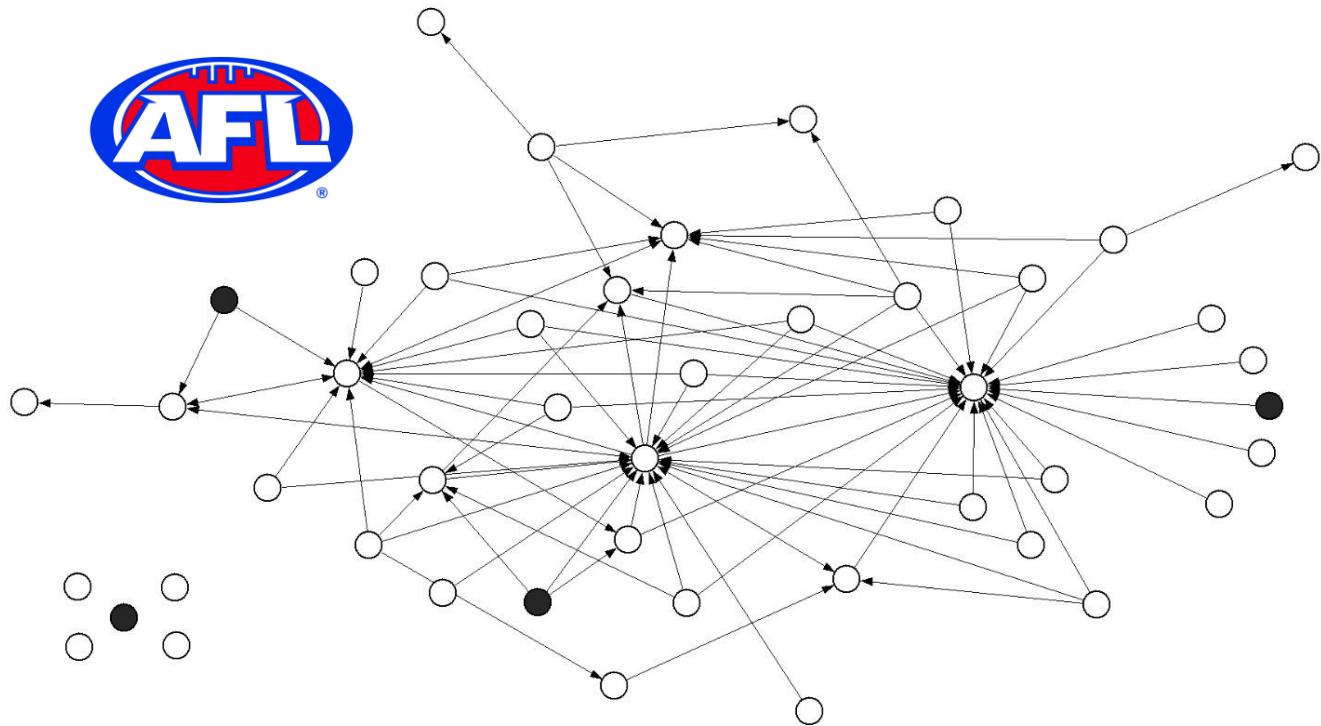
○ Players in a team
→ Friend



'The Glue' who control information flow

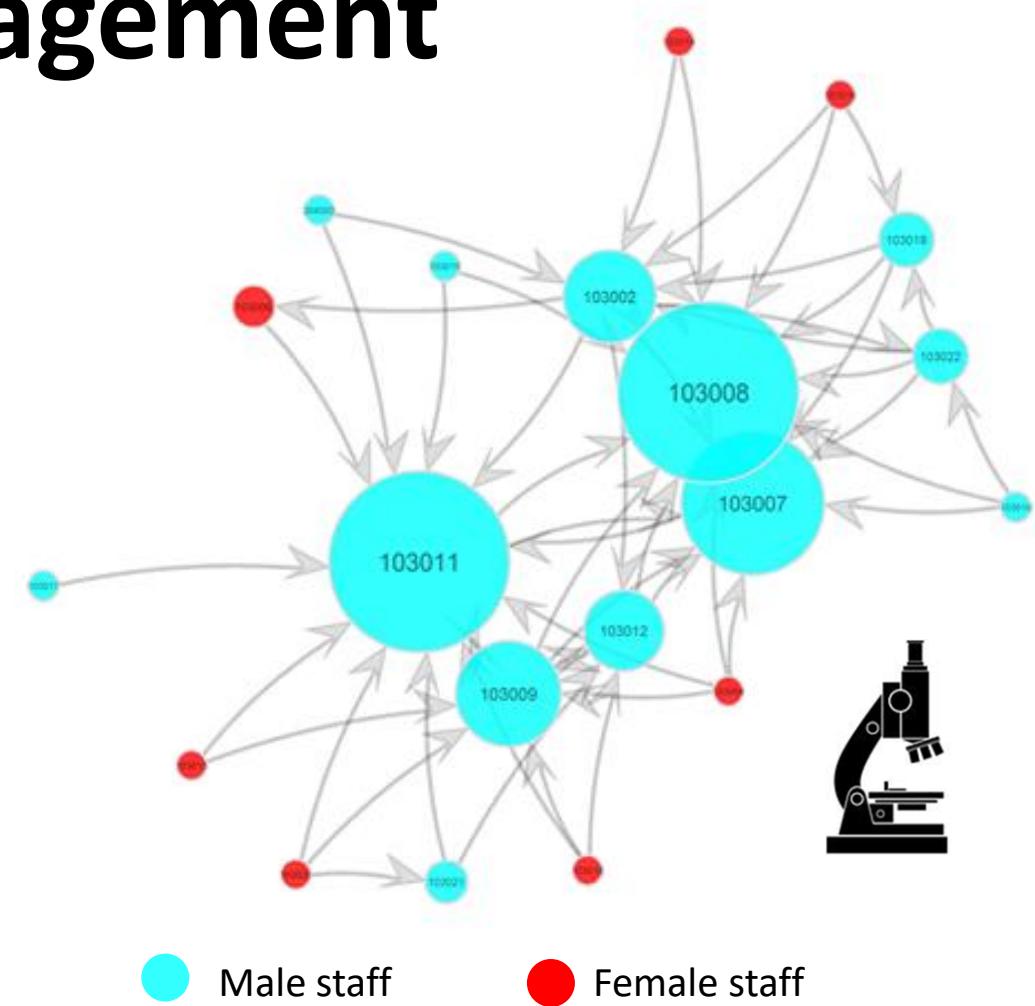
**Low
Performing
Team**
Fragmented

Diversity Management



● Indigenous staff

○ Non-Indigenous staff



● Male staff

● Female staff



Are people from diverse backgrounds *really* included?
Or are they just on the periphery?

The social is by definition relational

If we want to understand the social we need to understand social relations

We are “actors in social relations”
(Abbott, 1997: 1152)

SNA

A relational methodology for
a relational view of the world

Bring methods closer to theory

Social networks: some examples of domains of study

Anthropology

Kinship systems, social structures

Psychology

Interpersonal and group processes

Sociology and Demography

Structure of opportunity, status attainment
Sociology of science
Embeddedness of economic activity
Social media (and internet studies)

Political Science

Influence networks and elites
Policy networks
Interlocking directorates

Economics and Finance

Labour markets and informal networks
Markets and networks
Financial systems

Geography and Urban Planning

Social space, geography and place

Epidemiology and Public Health

Disease transmission; behaviour change

Management and organisational studies

Organisational effectiveness
Knowledge management

Computer Science

Analogue with computer networks, internet, WWW
Communication networks
Computational problems
(Relational) data mining

Mathematics and Statistics

Mathematics and statistics of networks

Physics

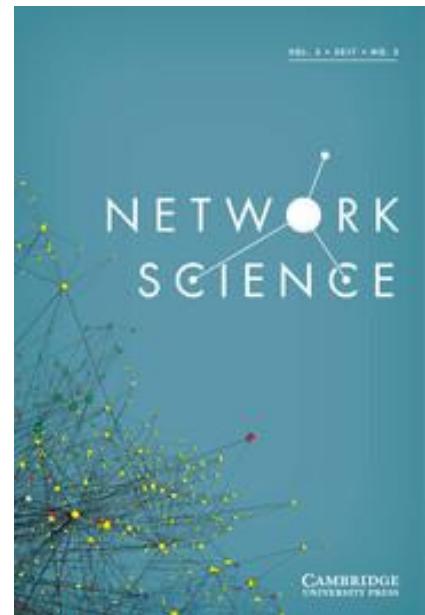
Complexity and universal laws

Education

Bullying, peer support
Performance

Social Network Analysis (SNA)

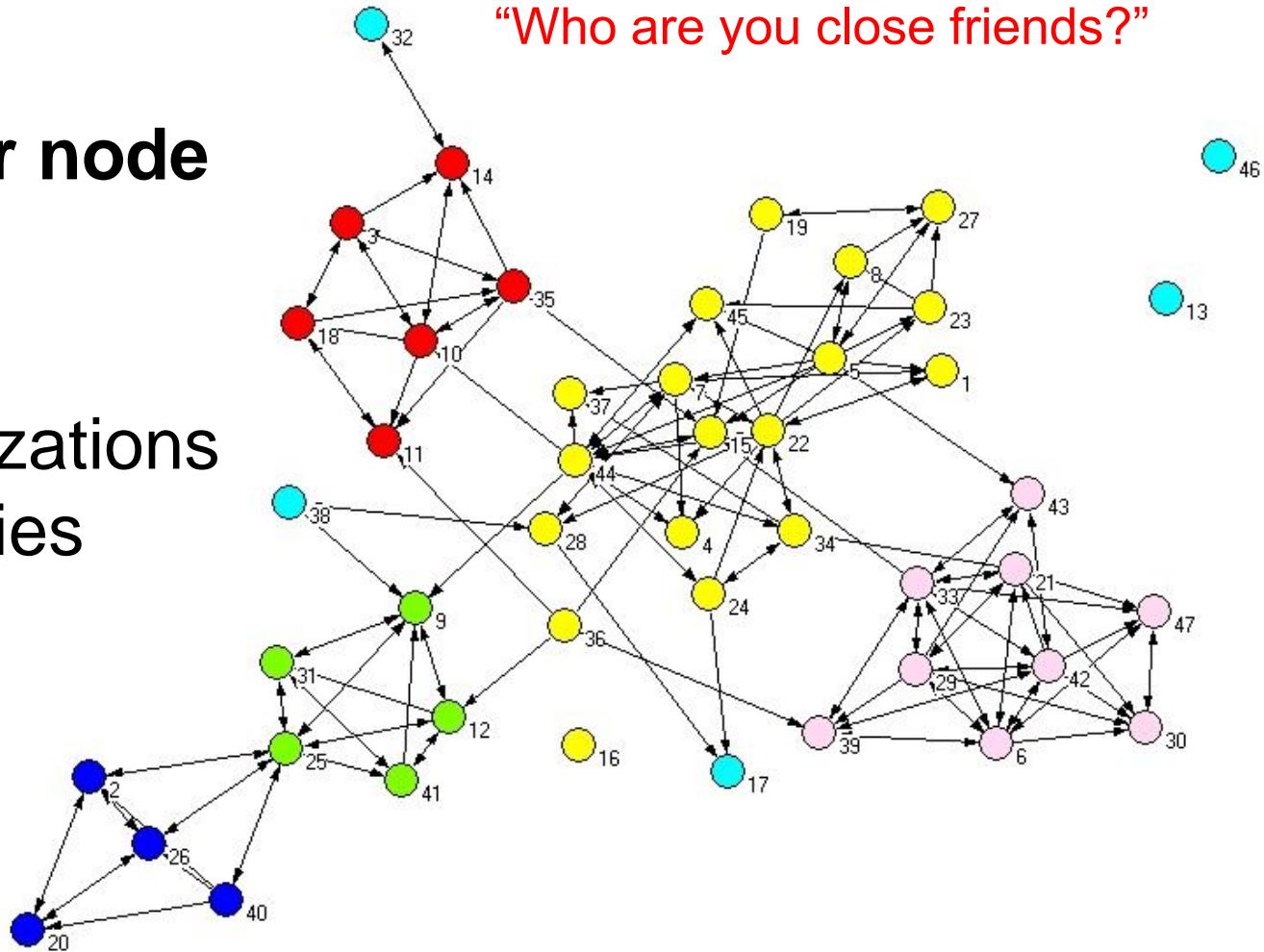
Network Science of connection



Actors or node

People
Teams
Organizations
Countries

“Who are you close friends?”



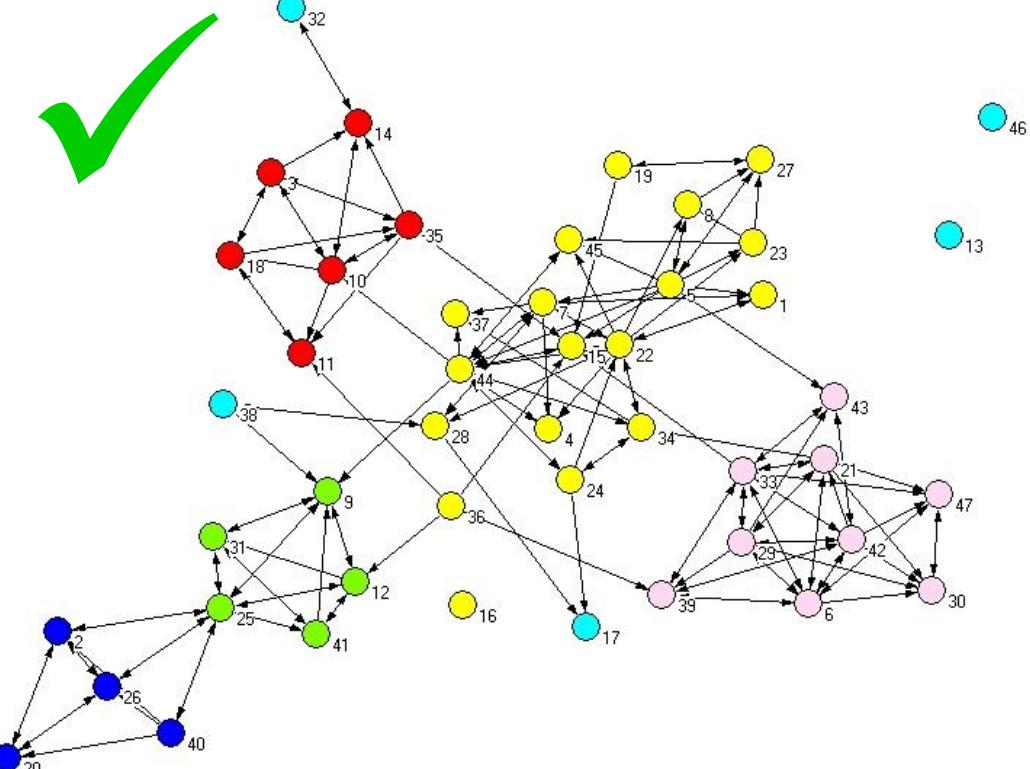
Relations, ties

Trust
Advice
Knowledge
Disagree with

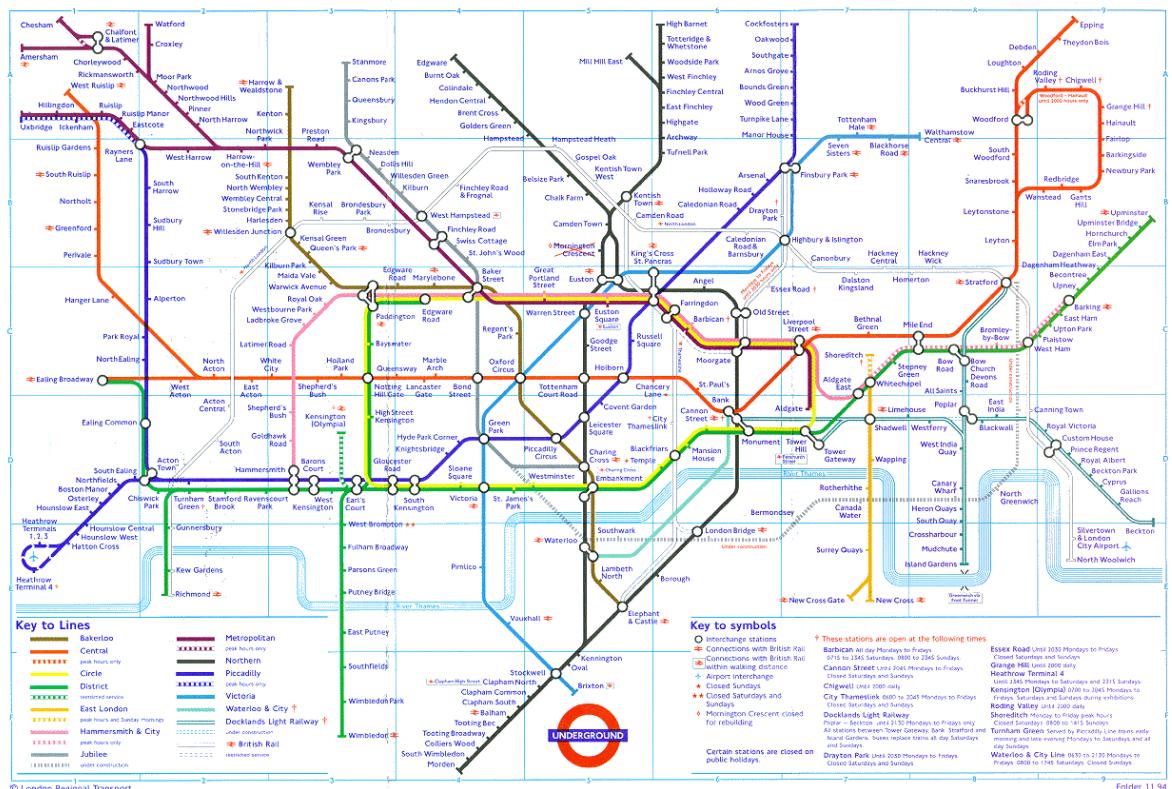
Social networks



A social network has emergent, ongoing
social processes
(i.e., network self-organization)



Communication between managers



London underground

Types of ties

There are *many* types of tie:

- acquaintance, friend, collaborator, confidant, advisor, sexual partner, ...

Some important distinctions

- relational versus transactional
- cognitive versus behavioural
- formal versus informal
- strong versus weak
- kin versus nonkin

Some theories of relationship

- elementary forms of relationship (Fiske, 1992, 2004)
- relational self (e.g., Anderson and Chen, 2002)
- relational schema for interdependent dyads (e.g., Holmes, 2000)

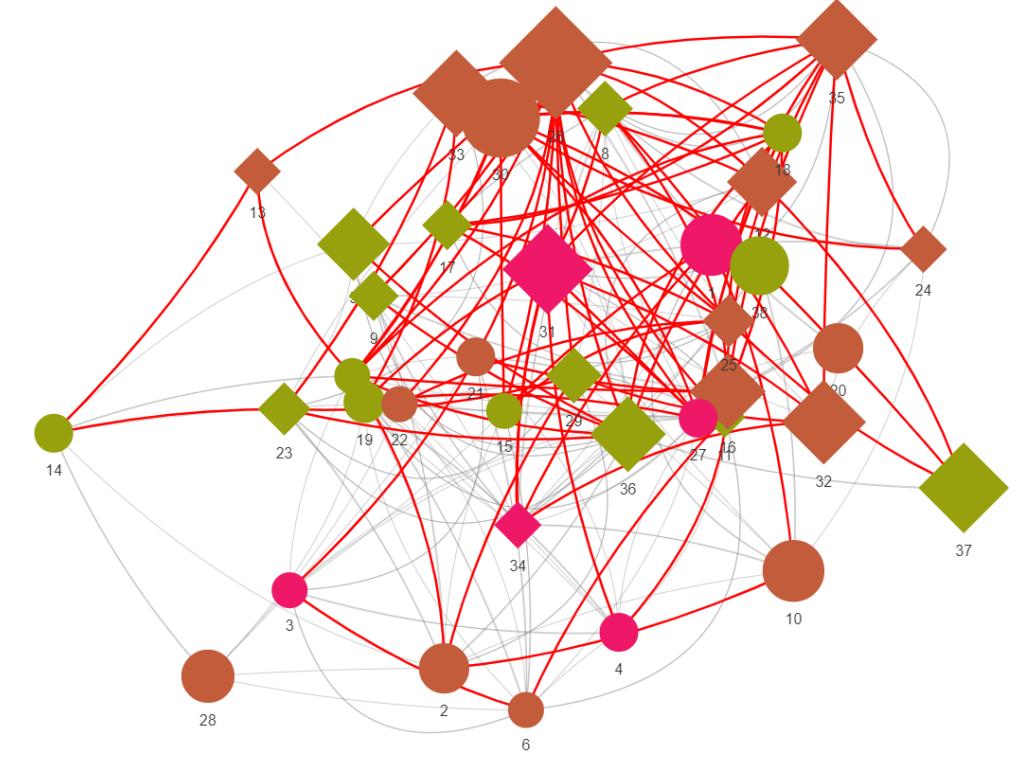
Types of nodes

- Persons
- Organisations
 - Government agencies, private firms, social groups, sports teams, communities.....
- Events
- Projects
- Places
- Online
 - Webpages, tweets, social media contacts
- Animals

Importantly, in social networks the nodes are *actors*

- they have **qualities**
(attributes, behaviours, attitudes, personalities)
- they have **motivations**
including motivations to select social partners to “optimise” their social structural locations (*social selection*)
- they are **subject to influence** (contagion) from network partners (*social influence*)
- they have **individual outcomes** and possibly **collective outcomes**.

Network Visualisation



New York Times, 3 April 1933

APRIL 3, 1933.

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 Society of the State of New York, which opens its 127th annual meeting here today at the Waldorf-Astoria.

The first series of maps of the new human geography were shown by Dr. Jacob L. Moreno of New York, consulting psychiatrist of the National Committee of Prisons and Prison Labor and director of research, New York State Training School for Girls, Hudson, N. Y.

Group of 300 Girls Studied.
In this manner an entire community of 300 girls in the State Training School for Girls was mapped. A total of 7,000 lines are needed to portray these relations and these in turn are the result of the gathering of a mass of data that covers 10,000 manuscript pages.

Two studies of communities have been made of 2,000 pupils in Public School 181, Brooklyn, and 250 boys at the Riverdale Country Day School. Boys are represented on the maps as triangles, and girls as circles.

A mere glance at the chart shows the strange human currents that flow in all directions from each individual in the group toward other individuals, from group to group, and from the entire group toward the individuals. Each group has its popular and unpopular members, and here and there an individual stands totally alone, isolated from the rest of the group. The isolated individuals, Dr. Moreno said, are either the most intelligent types or types of the lower order of intelligence. Similarly the maps show entire groups isolated from other groups.

"In looking at these charts," Dr. Moreno explained, "we find small entities forming within a group. Frequently the attraction of an individual reaches outside his group to another one wholly different from that in which he is placed by accident."

Galaxies are formed that take certain definite aspects. In some instances we will have a boy and a girl in the centre of a circle, all of whose members are attracted toward him or her, but with no reciprocal feeling going back."

"After the data of a community study are compiled and a chart made, we turn to a mathematical method of interpreting conditions. The ratio of total red and black lines inside and outside each group is computed. Quotients of attraction are determined. Anvils are formed to represent within each group the individuals who are isolated, rejected by the group."

Millions of Isolated Persons.
On the basis of percentages shown in the studies so far, according to Dr. Moreno, it can be estimated that, in proportion, there are from 10,000,000 to 15,000,000 isolated individuals in the United States. They are, Dr. Moreno added, "always getting the short end of everything. In convenience they suffer, are discontented, and reflect their unhappiness into the lives of others."

"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." In this manner, he said, a girl who was completely isolated in one community was transplanted to another, more congenial group, and became a leader. In this manner, also, it was predicted that two girls in a group would eventually run away, and the prediction came true a short time after.

On a large scale this study may mean that the 10,000,000 to 15,000,000 individuals in this country now rejected by the groups in which they live may be transplanted to other environments where they may become happy human beings.

"If we ever get to the point of charting a whole city or a whole nation," Dr. Moreno added, "we would have an intricate maze of psychological reactions which would present a picture of a vast solar system of intangible structures powerfully influencing conduct, as gravitation does bodies in space."

"Such an invisible structure underlies society and has its influence in determining the conduct of society as a whole. Deep psychological evolutions have been

Apr. 23, 1933
Page 17

Georg Simmel in 1908 spoke of the importance of dyads and triads

1933 Jacob L. Moreno invents the sociogram, and with it network diagrams

In 1954, John Barnes starts to use the term “social network” systematically and it takes off from here.

A **sociogram** is a graphic representation of social links that a person has. It is a graph drawing that plots the structure of interpersonal relations in a group situation

ROW
Who you
choose

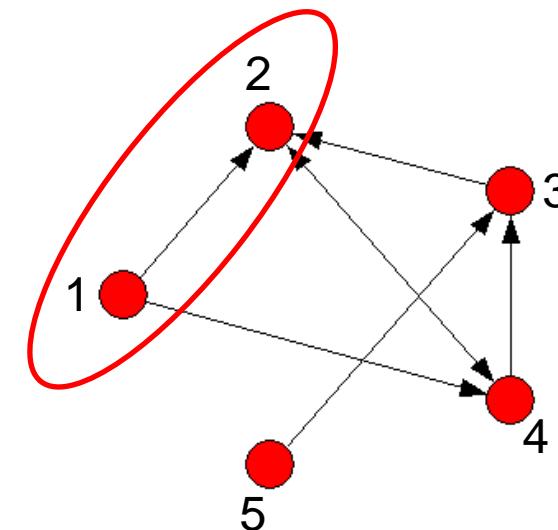
	0	1	0	1	0
0	0	0	1	0	0
0	1	0	0	0	0
0	1	1	0	0	0
0	0	1	0	0	0

COLUMN

Who chooses you

Sociomatrix

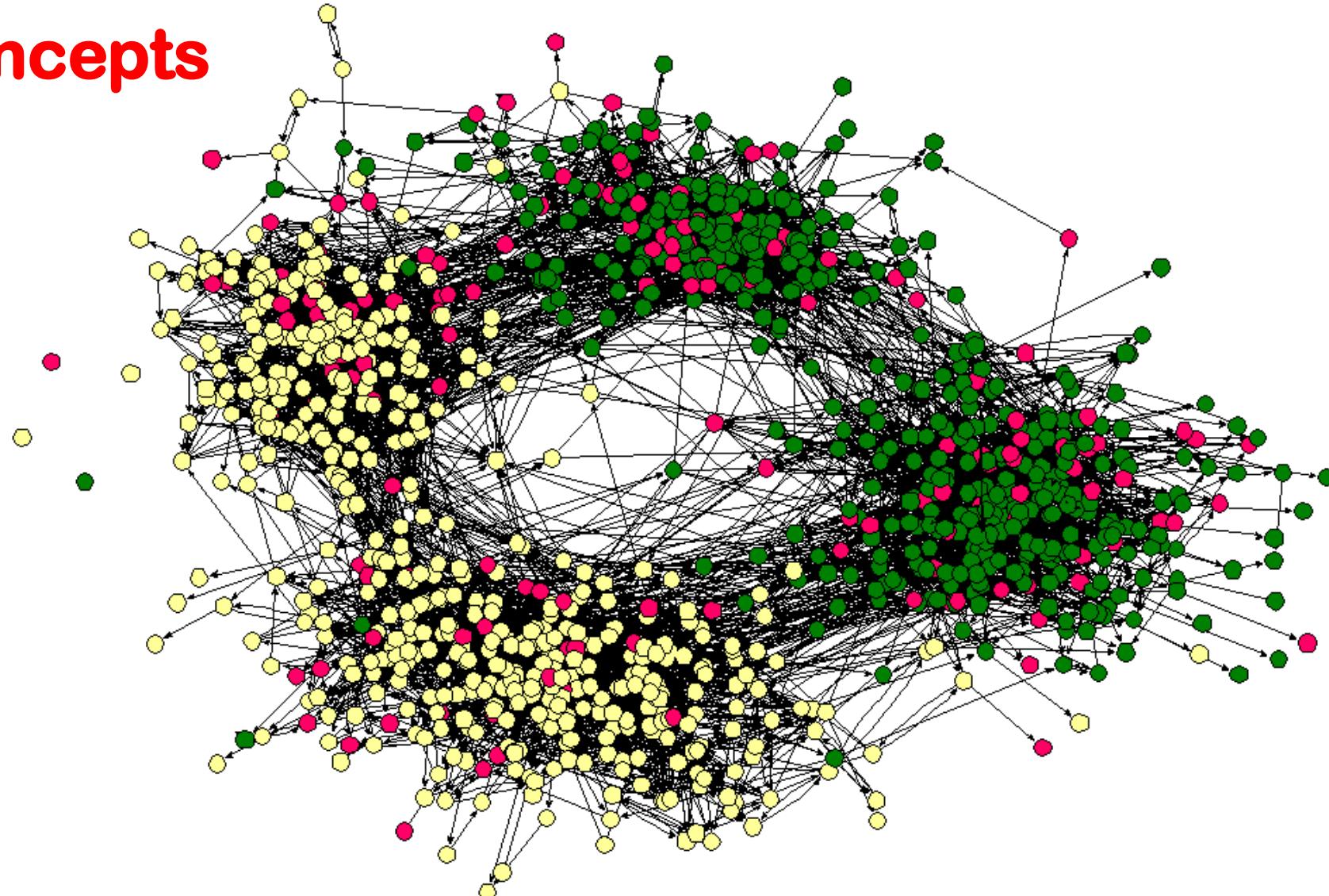
5×5



Sociogram

Network of size $n = 5$

New Concepts



High School friendship
Moody, 2001 – colours indicate
white/black/other

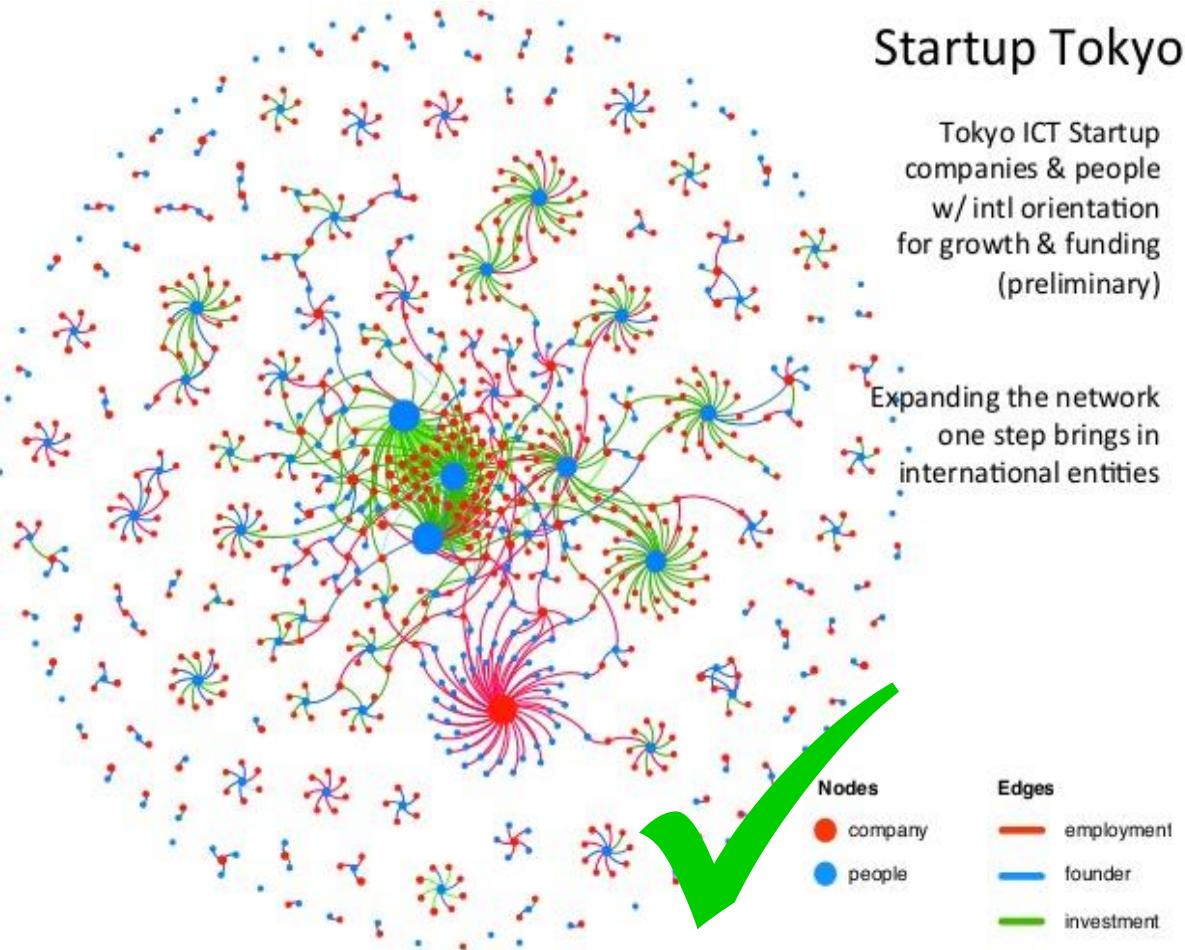
Homophily

Beyond Visualisation

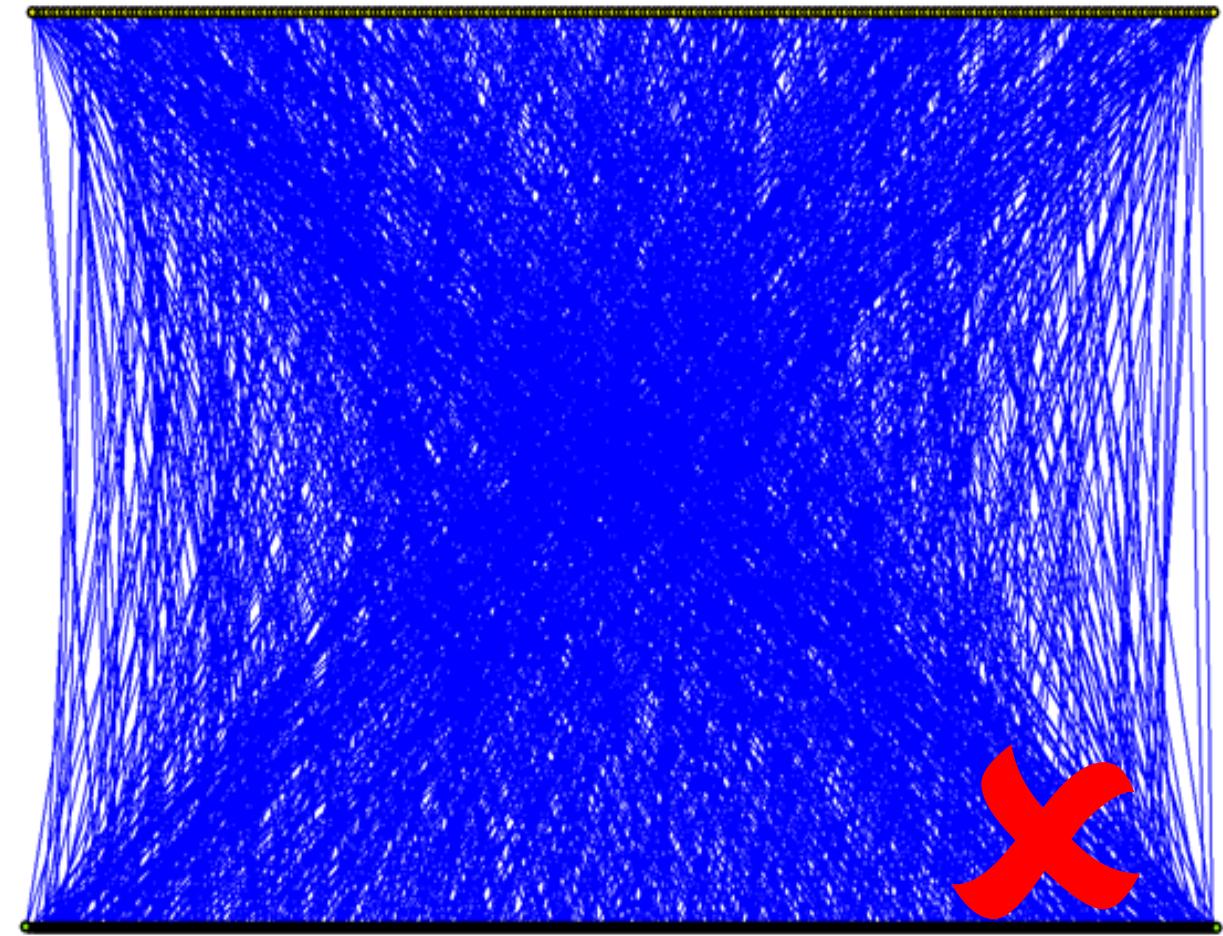


$$\Pr(\mathbf{Y} = \mathbf{y} \mid \mathbf{X} = \mathbf{x}) = \frac{1}{\kappa} \exp \left\{ \sum_Q \lambda_Q z_Q(\mathbf{y}) + \sum_R \lambda_R z_R(\mathbf{x}, \mathbf{y}) \right\}$$

Network visualisations are not always informative.....

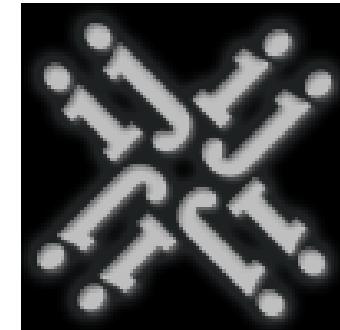
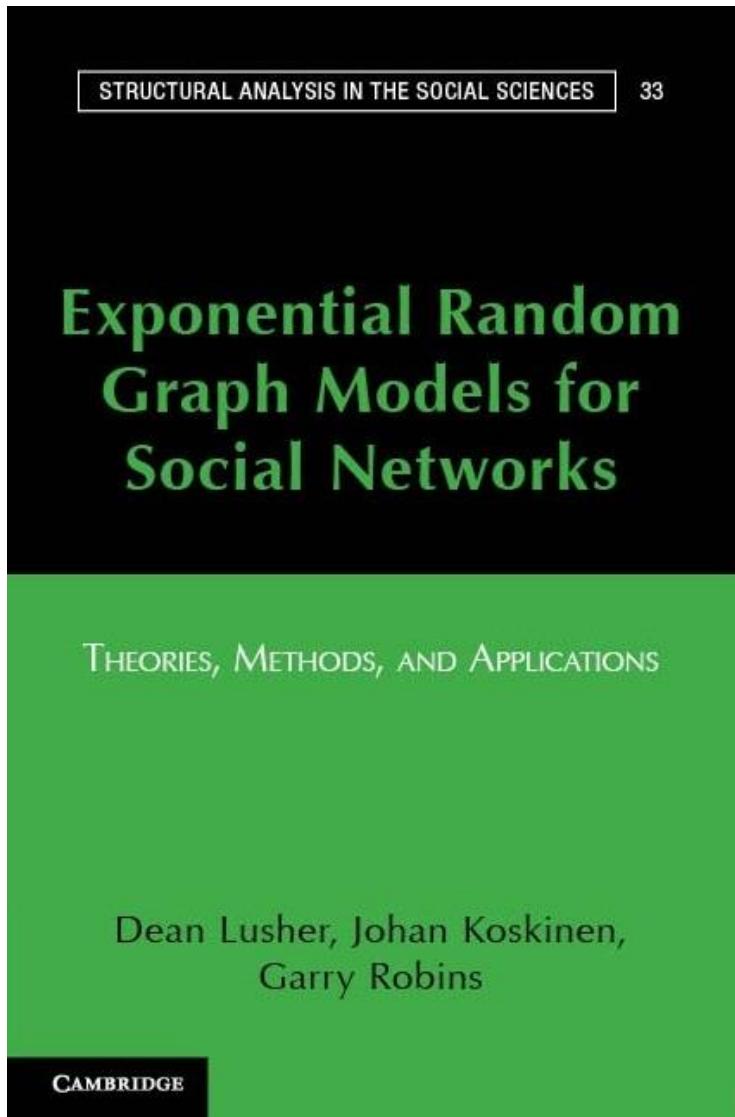


Startup ecosystem network in Tokyo



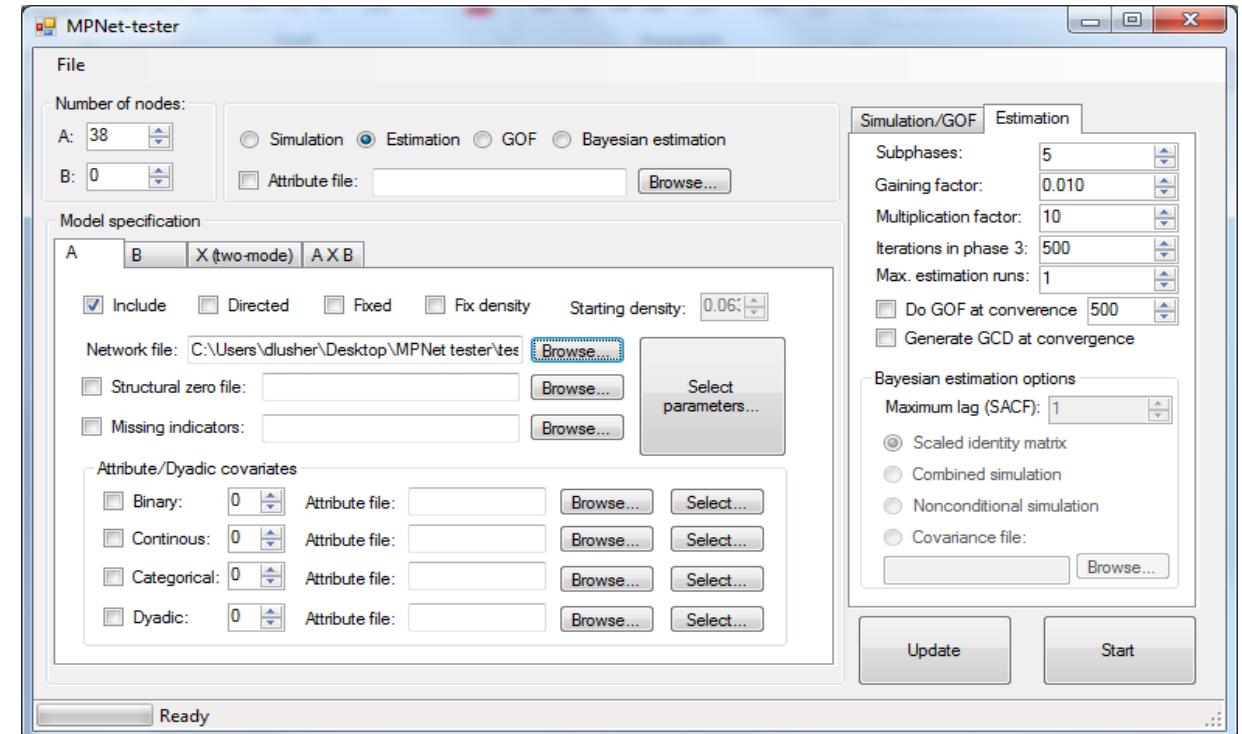
US companies & directors 1996

Network Science: Statistical network models



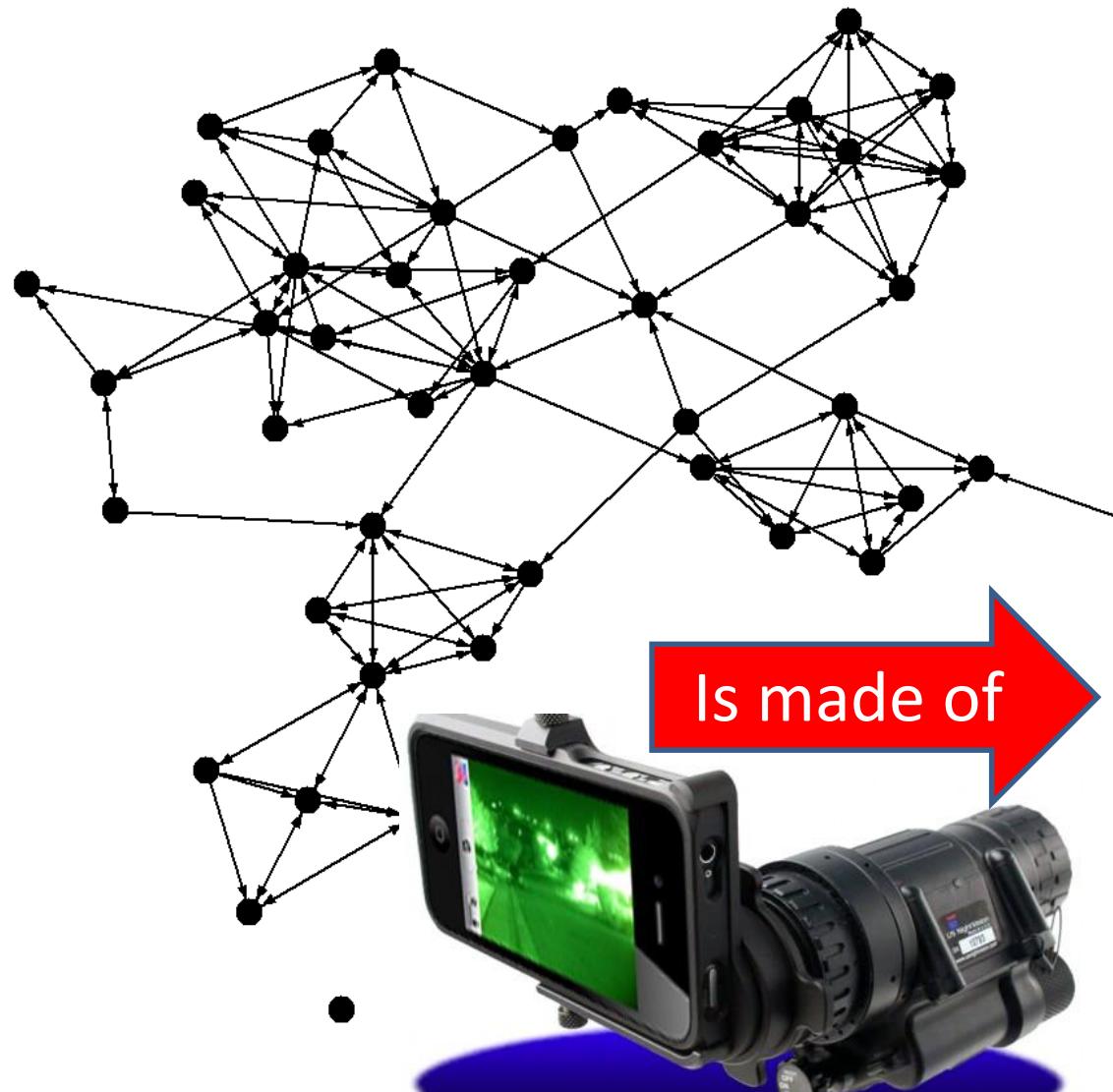
MPNet software
(Wang et al, 2018)

$$\Pr(\mathbf{X} = \mathbf{x}) = \frac{1}{K} \exp \left\{ \sum_Q \lambda_Q z_Q (\mathbf{x}) \right\}$$



Swinburne is a world-leader in statistical network models

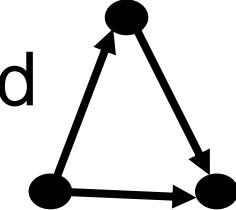
Networks are composed of sub-structures



You scratch my back....



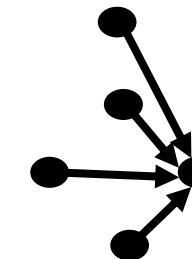
A friend of a friend is a friend



The Broker



Follow the leader



Local everyday
'social rules'

Not essential
that rules
are followed

Birds of a feather.....



The High Connector



Network effectiveness

Value of networks?

- What is the **structure** of the network?
 - How did it come about? What explains the ties?
 - Focus on social ties
 - E.g., Is my organisation siloed?
- How do connections to others affect **outcomes**?
 - Depression, disease, employment, new insights?
 - Node-level outcomes
 - E.g., Does my advice network within my organisation impact on my individual performance?
 - System-level outcomes
 - E.g., Does employee collaboration lead to successful project outcomes?

