Week 8: Cascades/CW Tutorial

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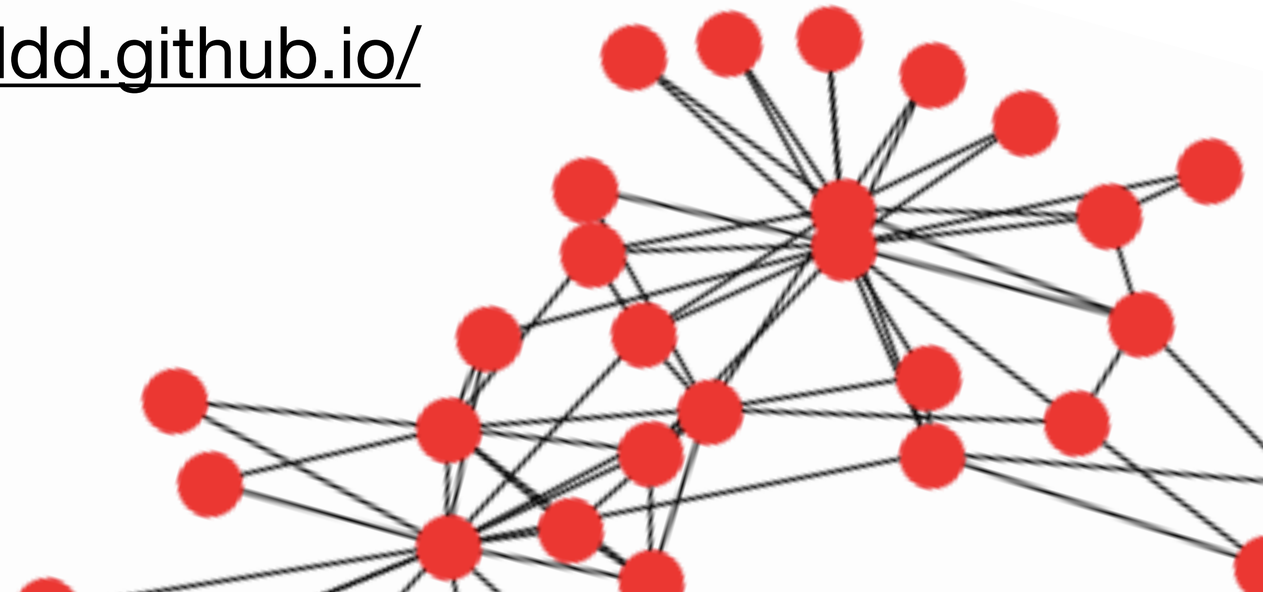
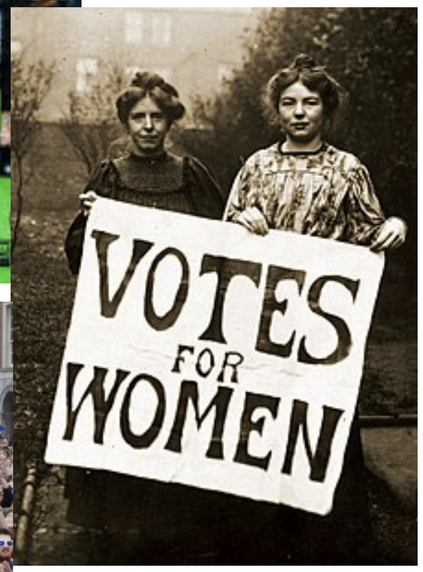
https://narnolddd.github.io/



Tutorial aims

- **Recap** the cascades lecture
- **Go over** a cascade threshold example
- **Get some pointers for** where to start with the network analysis coursework, with Gephi demo
- If **time_left > 0**, answer some coursework questions

What can be modelled as a cascade?



Movements to change a consensus

Uptake of new technologies/products

Important features

- Each agent (node) is in **one of two states** — adopter or non-adopter
- **State** of a node depends only on that of its **neighbours**. I.e. grass-roots and no outside influence
- Each node acts **rationally**

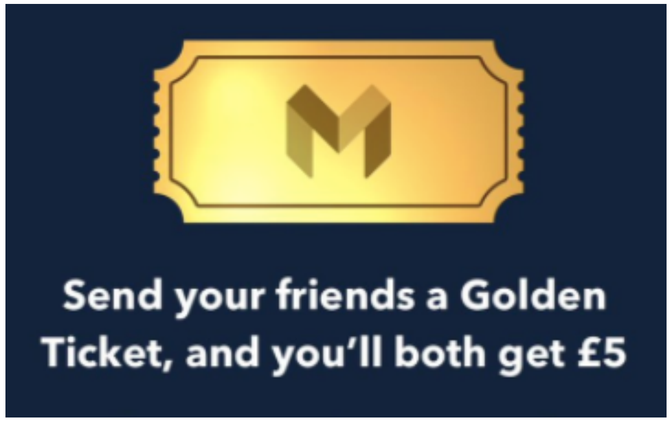
Game-theoretic formulation

- Pair of nodes ***v*** and ***w*** in a social graph
- Behaviours **A** and **B**
- If both adopt **A**, they each get a payoff **a** > 0
- If both adopt **B**, they each get a payoff **b** > 0
- If they adopt **opposite** behaviour, both get a payoff of 0

v \ ***w***	**A**	**B**
A	a,a	0,0
B	0,0	b,b

What can payoff mean?

Social cohesion: easier (maybe!) to be friends with someone you agree with on something



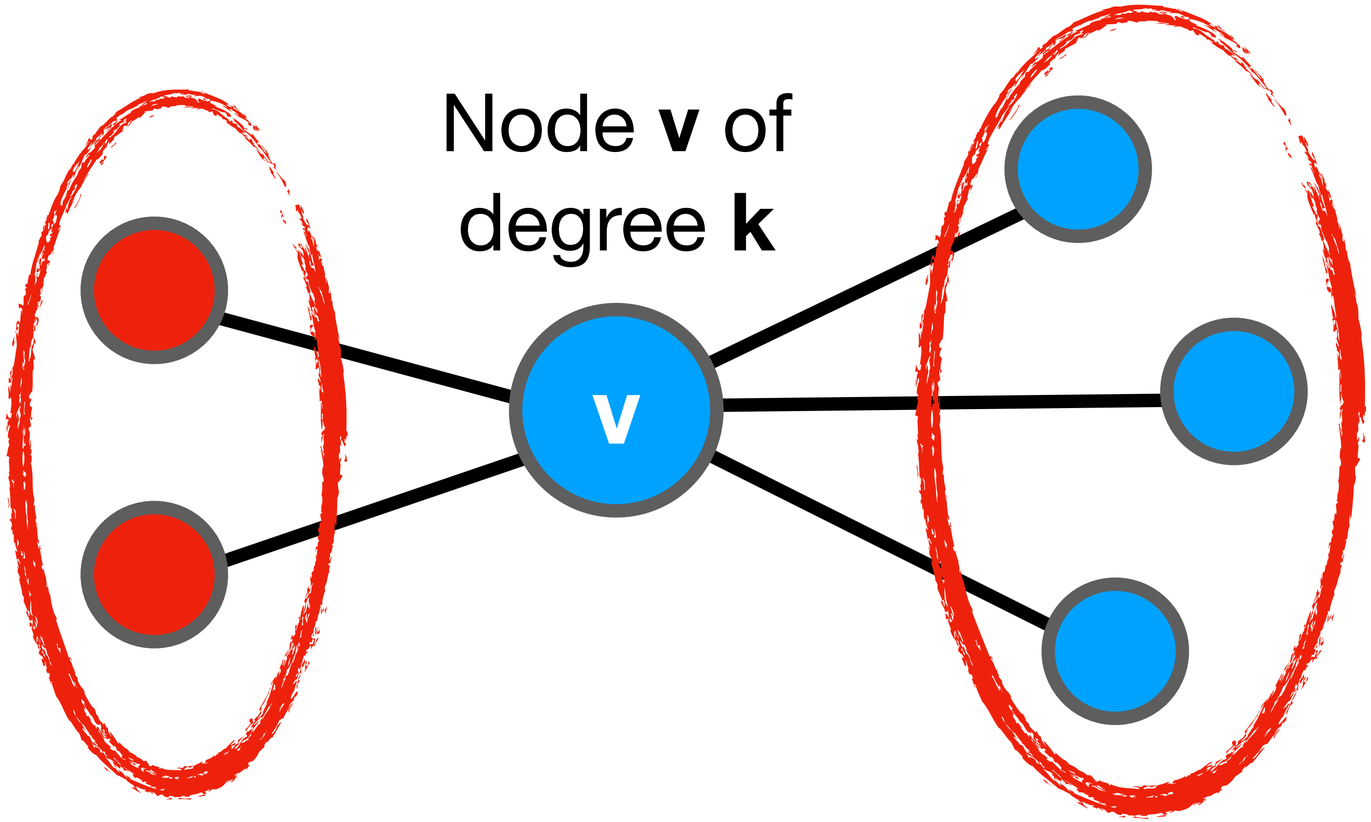
(Monzo bank scheme)

Literal cash: Receive incentives for adopting or encouraging others to adopt

Other benefits: using same technologies/ platforms

Cascade threshold

Proportion **p** of **v**'s neighbours adopt **new** behaviour **A**



The rest (proportion **1-p**) stick with **old** behaviour **B**

v's payoff for adopting **A:**

$$pka$$

v's payoff for adopting **B:**

$$(1-p)kb$$

Cascade threshold

Adopting new behaviour
A is a better* option if:

$$pka \geq (1-p)kb$$

$$p \geq \frac{b}{a+b}$$

*assuming nodes are rational and want option with best payoff — not always the case in reality!!

Cascade threshold

Adopting new behaviour **A** is a better* option if:

$$pka \geq (1-p)kb$$

$$p \geq \frac{b}{a+b}$$

Cascade threshold — proportion of neighbours you need to **convince** you to adopt behaviour **A!**

*assuming nodes are rational and want option with best payoff — not always the case in reality!!

Cascade threshold interpretation

Small threshold

$< 1/2$

New behaviour appealing, little convincing needed

Threshold equal to

$1/2$

People will simply follow majority of their friends

High threshold

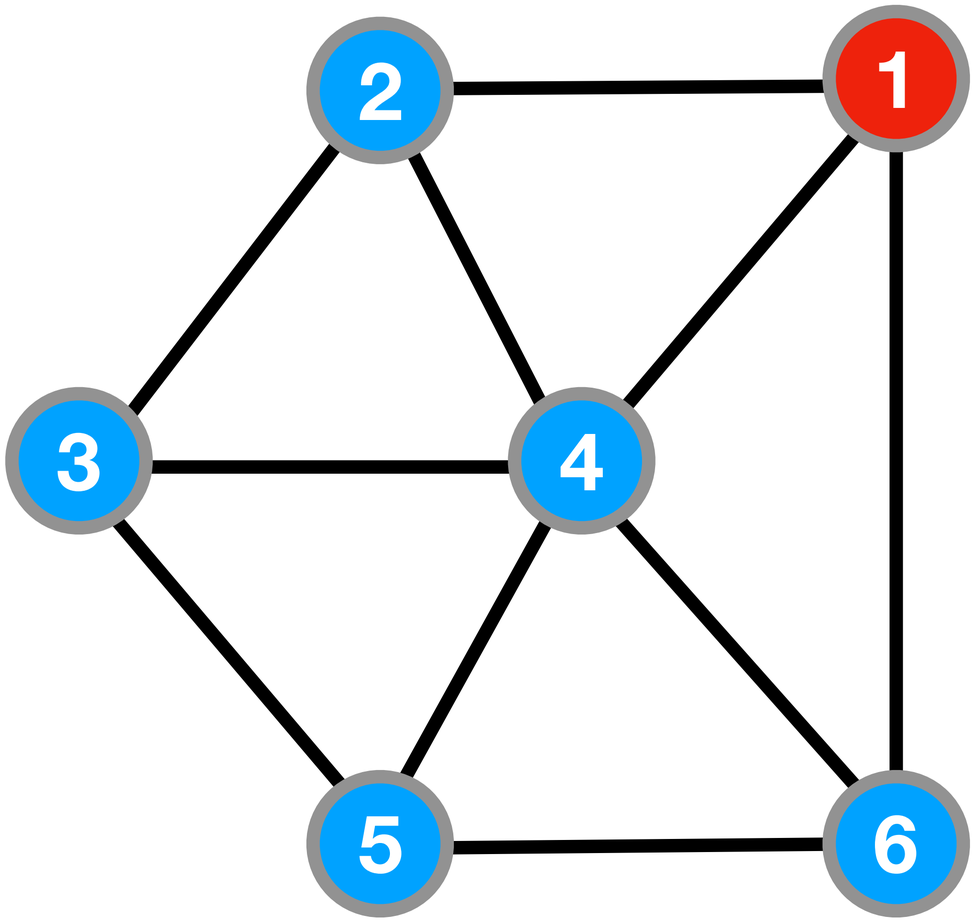
$> 1/2$

New behaviour less appealing, need critical mass of initial adopters

Example

a = 3, b = 1

Threshold
= b/(a+b)
= 1/(1+4)
= 1/4



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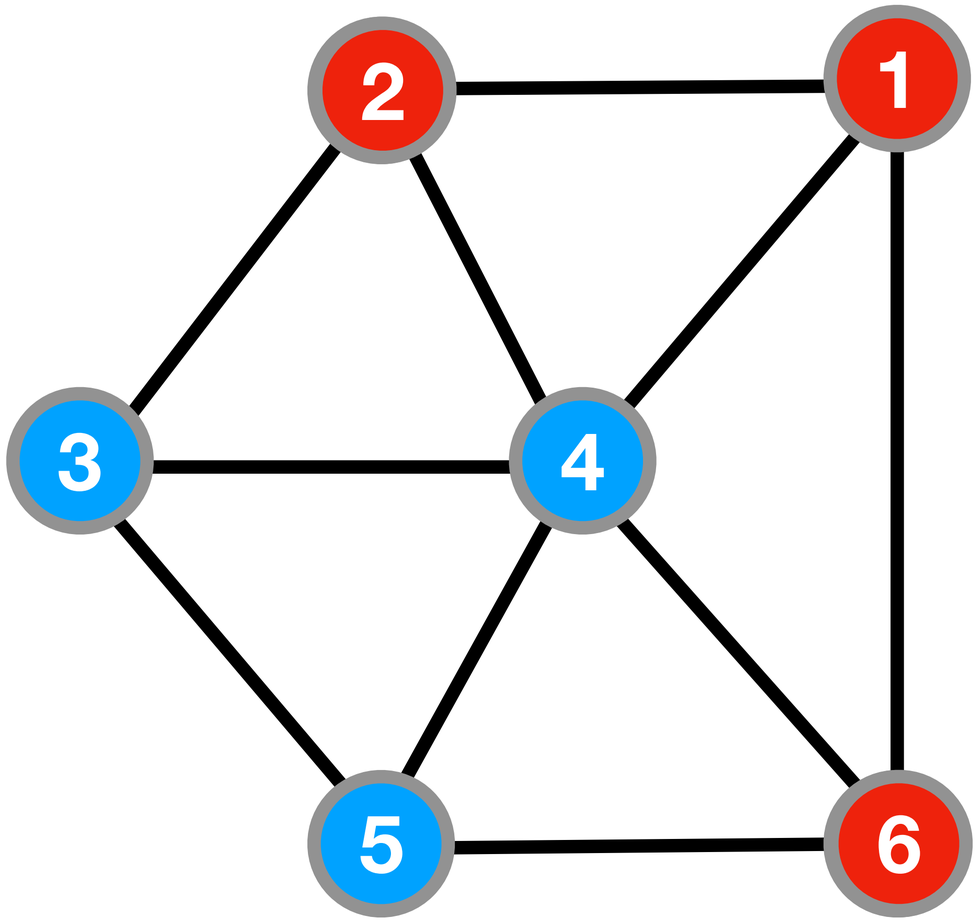

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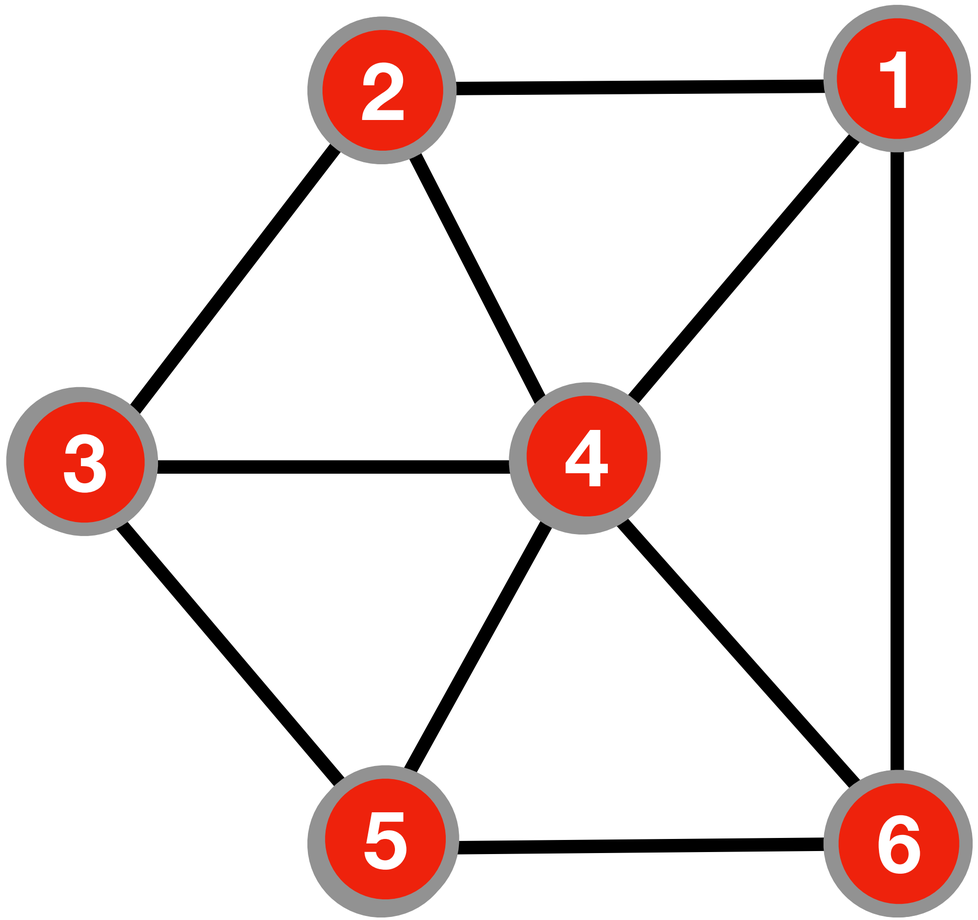

Example

a = 3, b = 1

Threshold
= b/(a+b)
= 1/(1+4)
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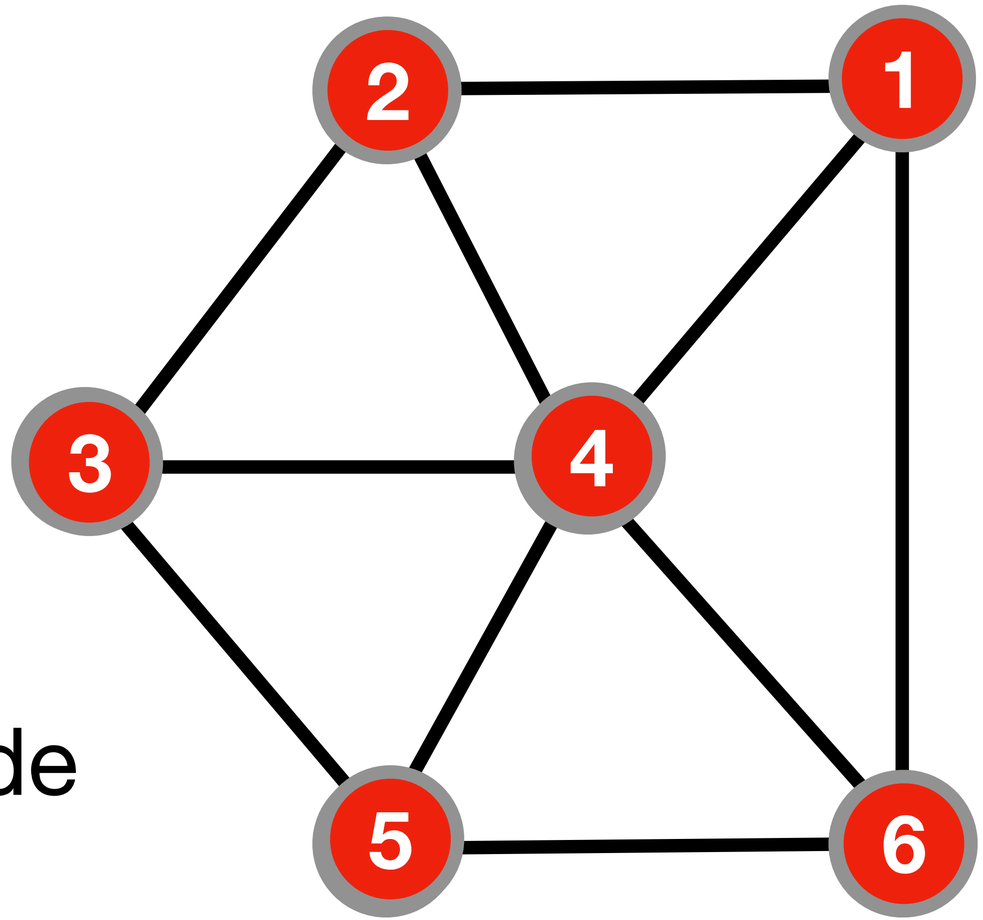
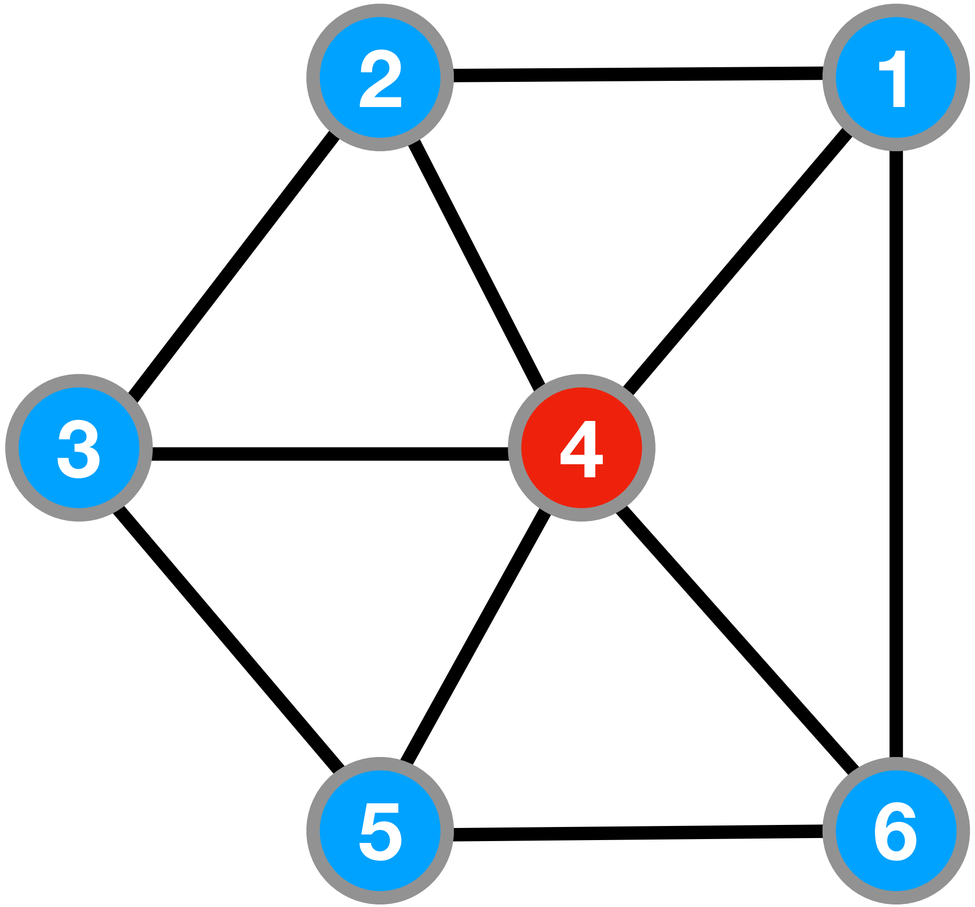
Leads to **complete** cascade



Example

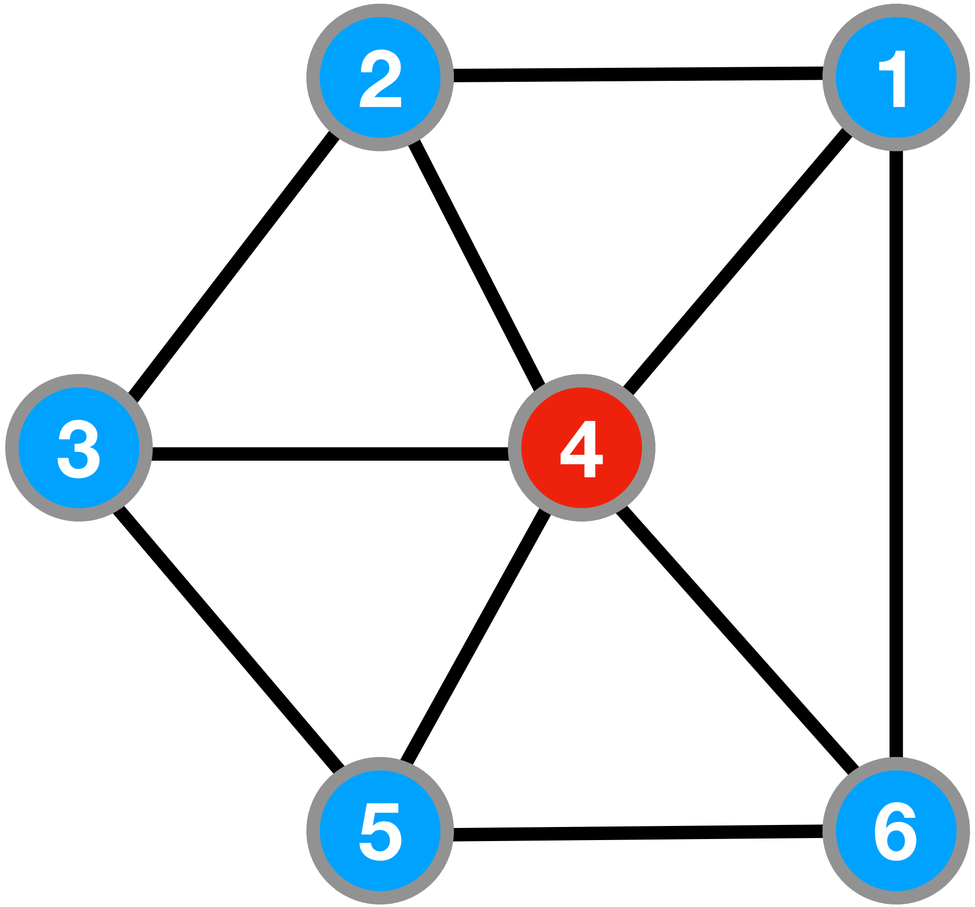
What threshold would you need to generate a cascade from this node?



Example

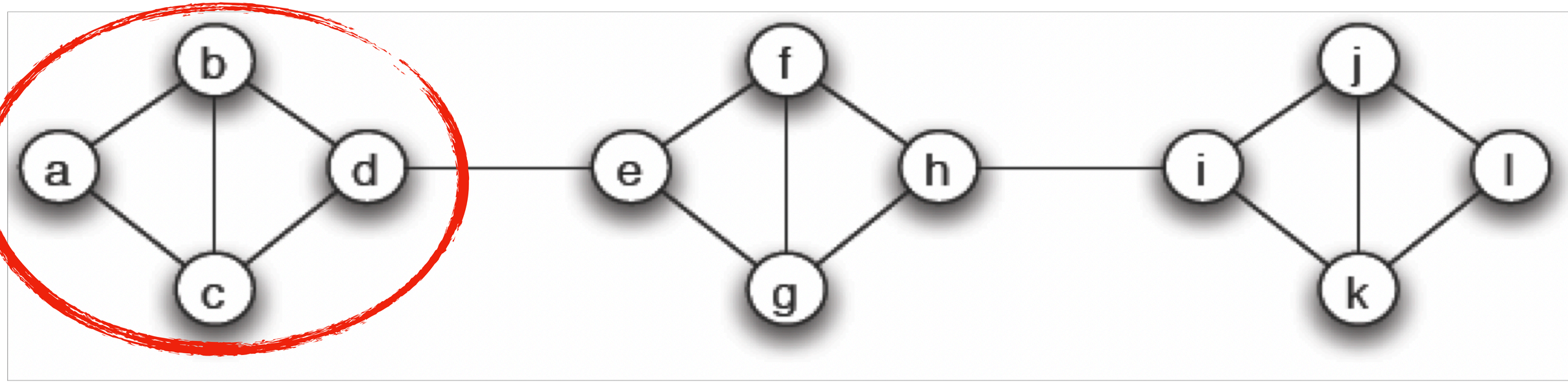
What threshold would you need to generate a cascade from this node?

Each neighbour has degree **3**, so anything lower than **1/3** will generate cascade



Effects of network structure

Weak ties between **tightly clustered** communities **stop** **cascades**



Cascade threshold would need to be **lower than 1/3**
for **e** to be convinced to **pick up new behaviour**

Studying systems as networks

Studying systems as networks

System of interest
e.g. the Internet, the human brain, Twitter, real social networks

Studying systems as networks

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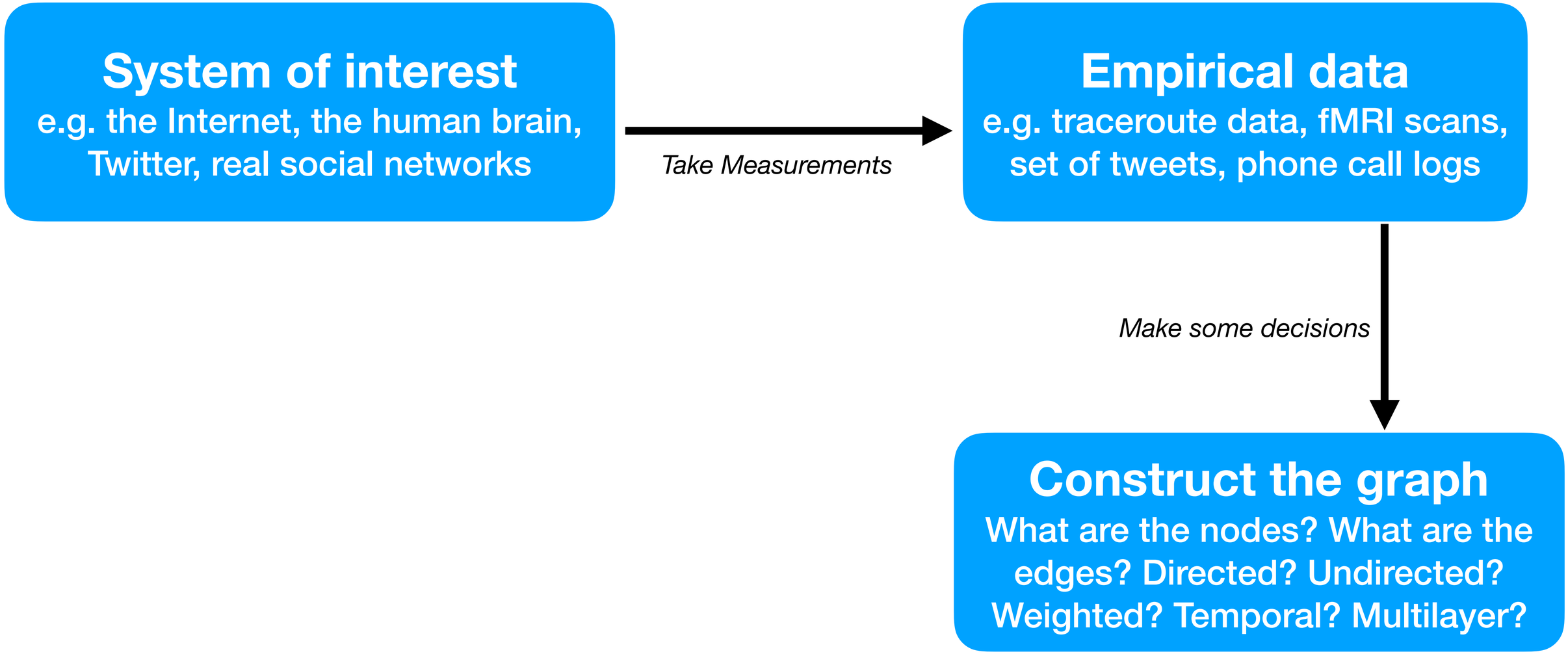
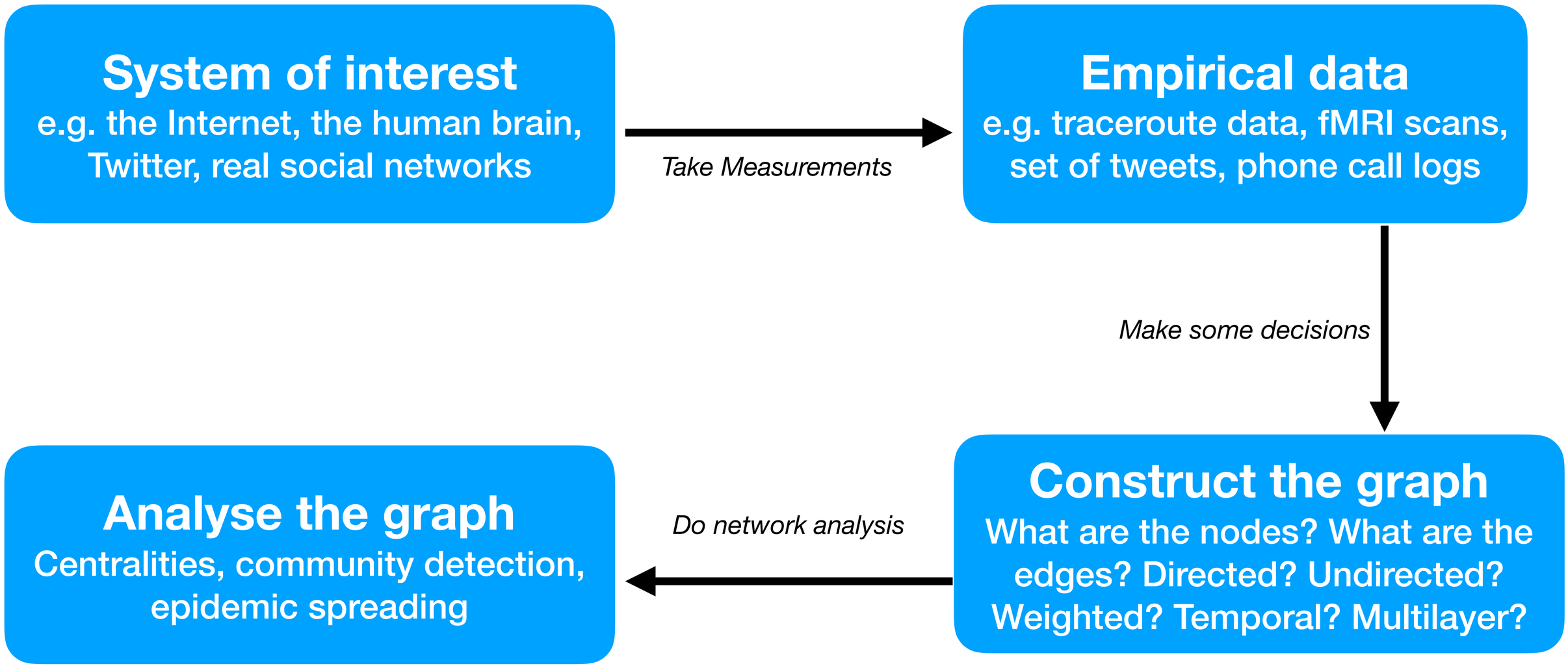
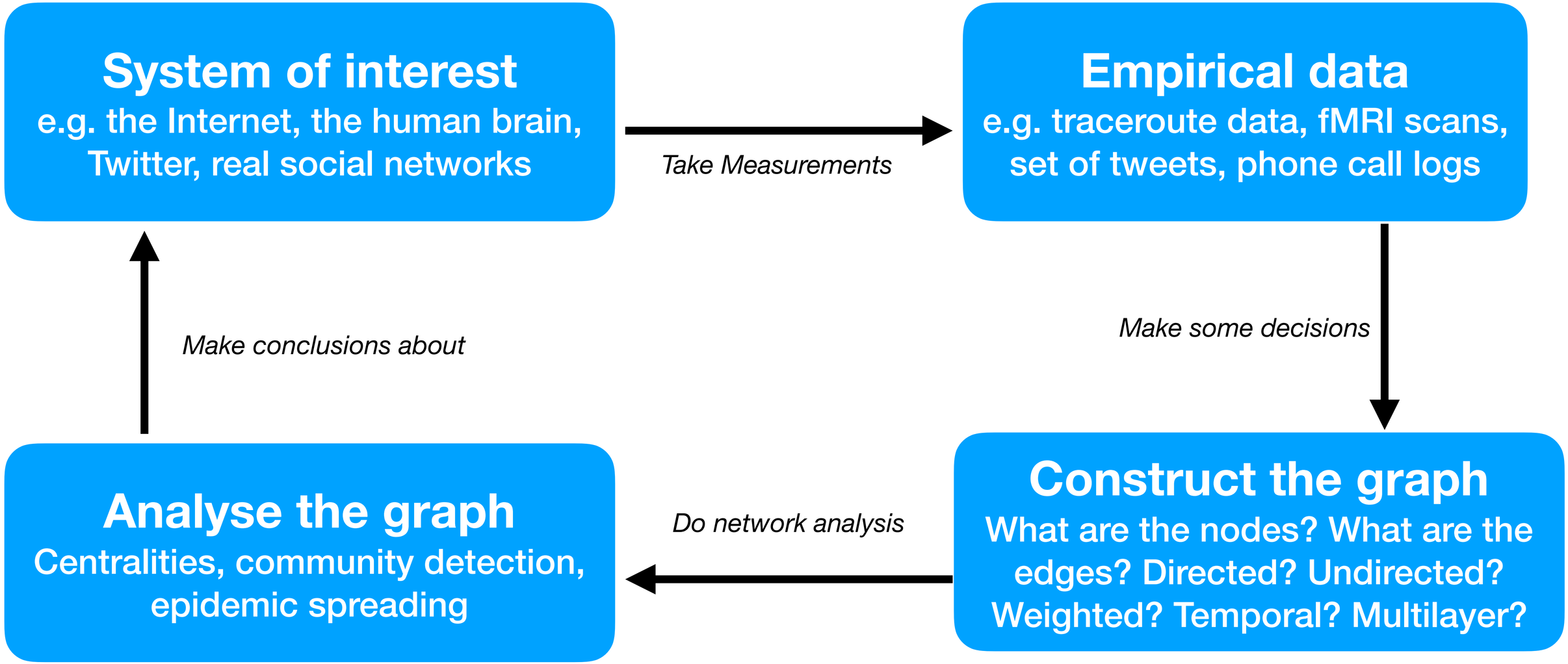


Studying systems as networks

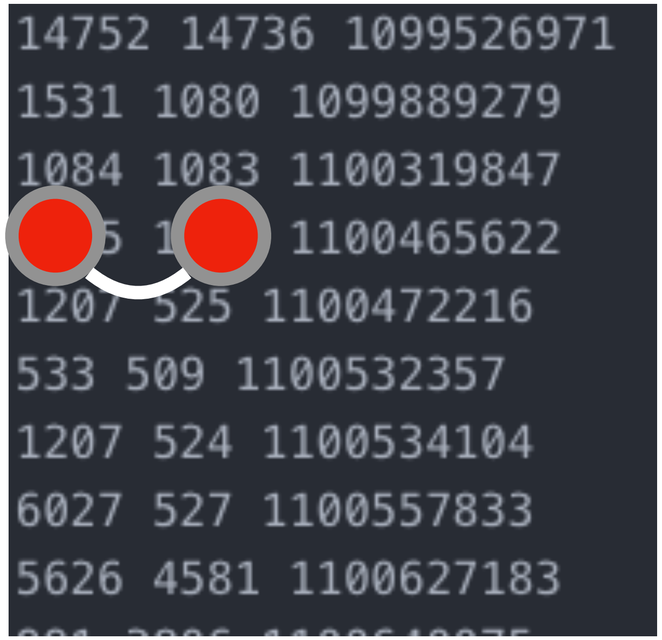


Studying systems as networks



Data Types: Edge List

- Usually a list with each row having **2 or more** comma/tab separated values
- First two values are **source** and **destination** nodes of edge
- Any extra values are **metadata** e.g. timestamp, edge weight

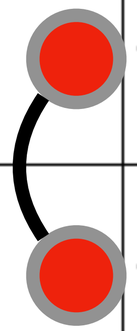


e.g. Facebook wall post dataset has user ids of wall poster and postee resp., and UNIX timestamp of when post was created

[Bimal Viswanath et al On the evolution of user interaction in Facebook. In *Proc. Workshop on Online Social Networks*, pages 37--42, 2009.]

Data types: Databases

eventName	eventSec	id	matchId	matchPeriod	playerId	positions	subEventId	subEventName	tags
Pass	1.656214	258612104	2057954	1H	122671	[{'y': 50, 'x': 50}, {'y': 53, 'x': 35}]	85	Simple pass	[{'id': 1801}]
Pass	4.487814	258612106	2057954	1H	139393	[{'y': 53, 'x': 35}, {'y': 19, 'x': 75}]	83	High pass	[{'id': 1801}]
Duel	5.937411	258612077	2057954	1H	103668	[{'y': 81, 'x': 25}, {'y': 83, 'x': 37}]	10	Air duel	[{'id': 703}, {'id': 1801}]



More complicated example: FIFA dataset where edges could be passes, specific types of passes, tackles etc.

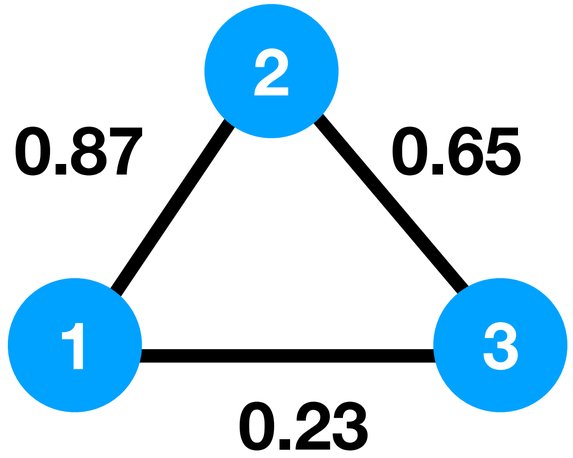
[Luca Pappalardo et al, A public data set of spatio-temporal match events in soccer competitions, 2018, Nature]

Data Types: Adjacency/Weight Matrix

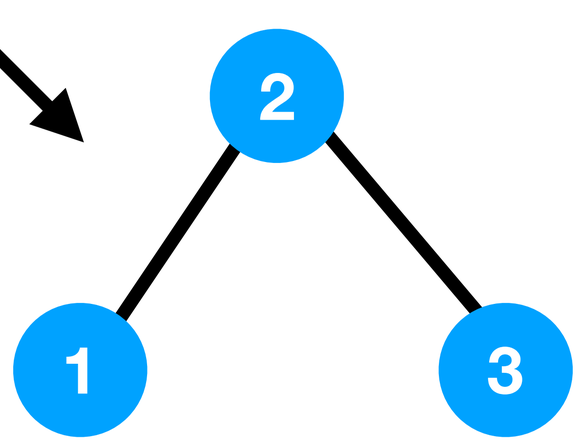
Dest Node

Source Node

	1	2	3
1	0	0.87	0.23
2	0.87	0	0.65
3	0.23	0.65	0

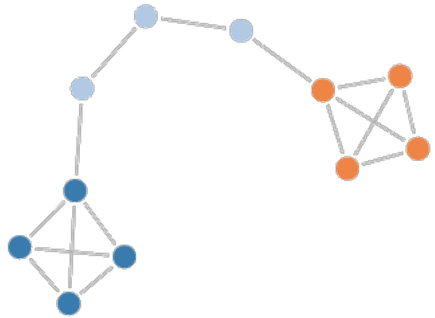


Threshold 0.6

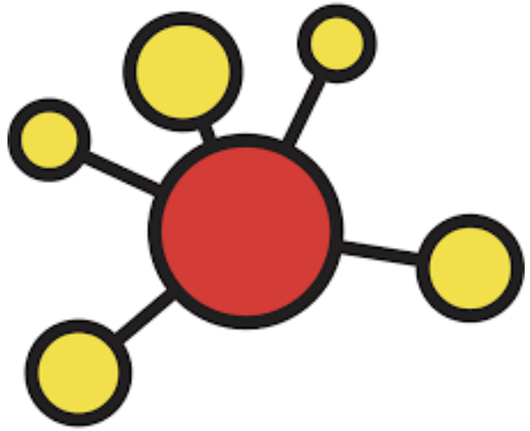


Value at **row i** and **column j** is the weight between node i and j

Software/libraries for network visualisation



NetworkX



(iGraph)

Gephi

Aaagh, my network is too big — thinning

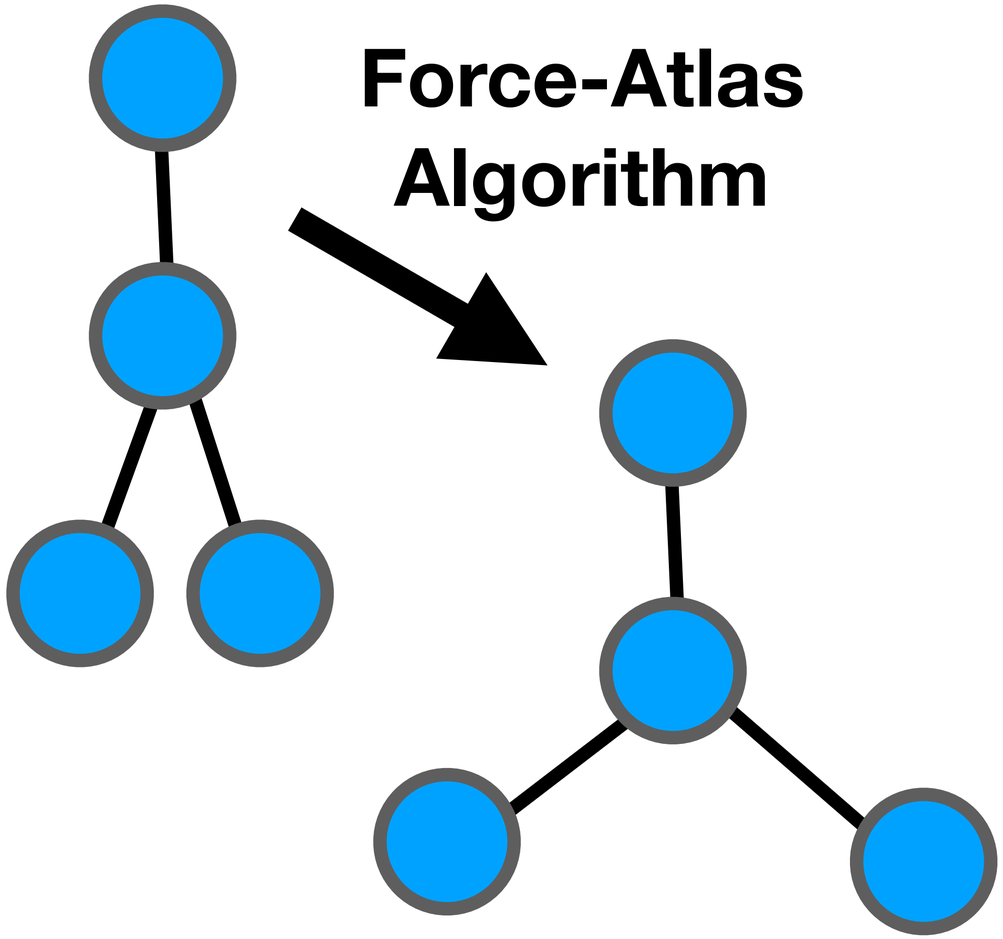
- **Windowing** — if the edges in your dataset have timestamps, look only at edges within a certain time window.
- **Random edge sample** (requires preprocessing in e.g. Python) — take a random sample of the edges in the dataset.
- **Random node sample** — take the network you get from a random sample of the nodes
- **Degree filter** — only include nodes of above a certain degree (e.g. get rid of nodes of degree 0,1)

Network visualisation ingredients

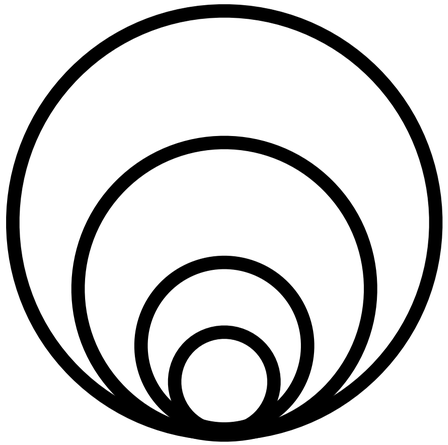
- **Node positions** — where the nodes are placed in the space?
- **Node features** — size/colour/shape?
- **Edge features** — thickness, colour?

Node Positions

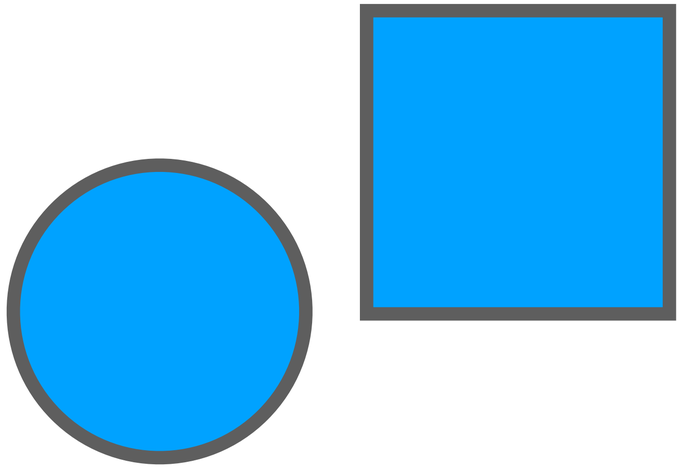
- Want to minimise **edge crossover**
- Put nodes that are **close to each other** by hops close to each other in the space
- **Layout algorithms** help with this (but are not perfect)



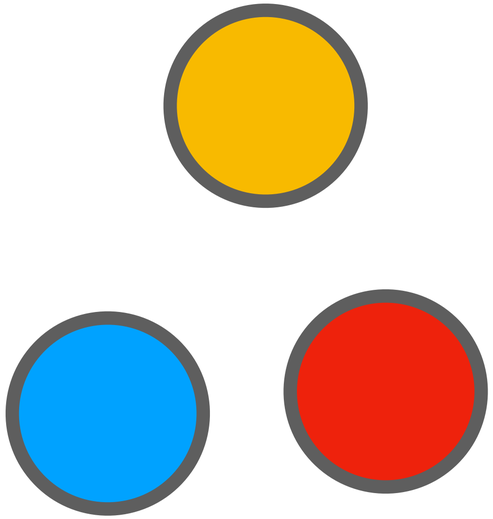
Node Properties



Size (usually some centrality measure)



Shape (different type of nodes in the graph?)



Colour (usually community-related)

Rest of tutorial: Gephi Demo

Dataset of Twitter interactions during a conference centred around the #NetSci2018 hashtag, collected by Ulf Aslak
https://gist.github.com/ulfaslak/2686ebe674b761e7947aacd2780b8384