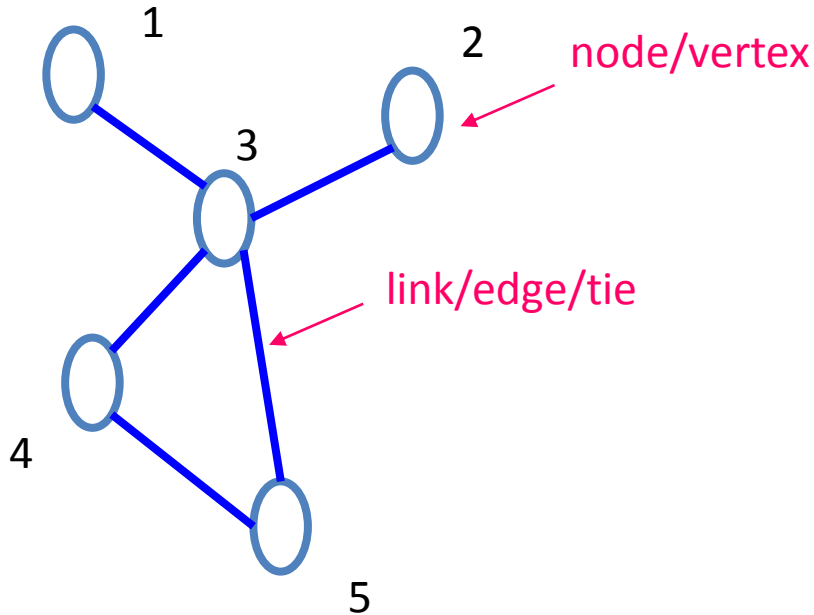


COMP9311 Advanced Topics: Social Network Analysis

INTRODUCTION – What are Networks

- **Networks** are collections of **points** joined by **lines**.



“Network” \equiv “Graph”

INTRODUCTION – Why we study networks

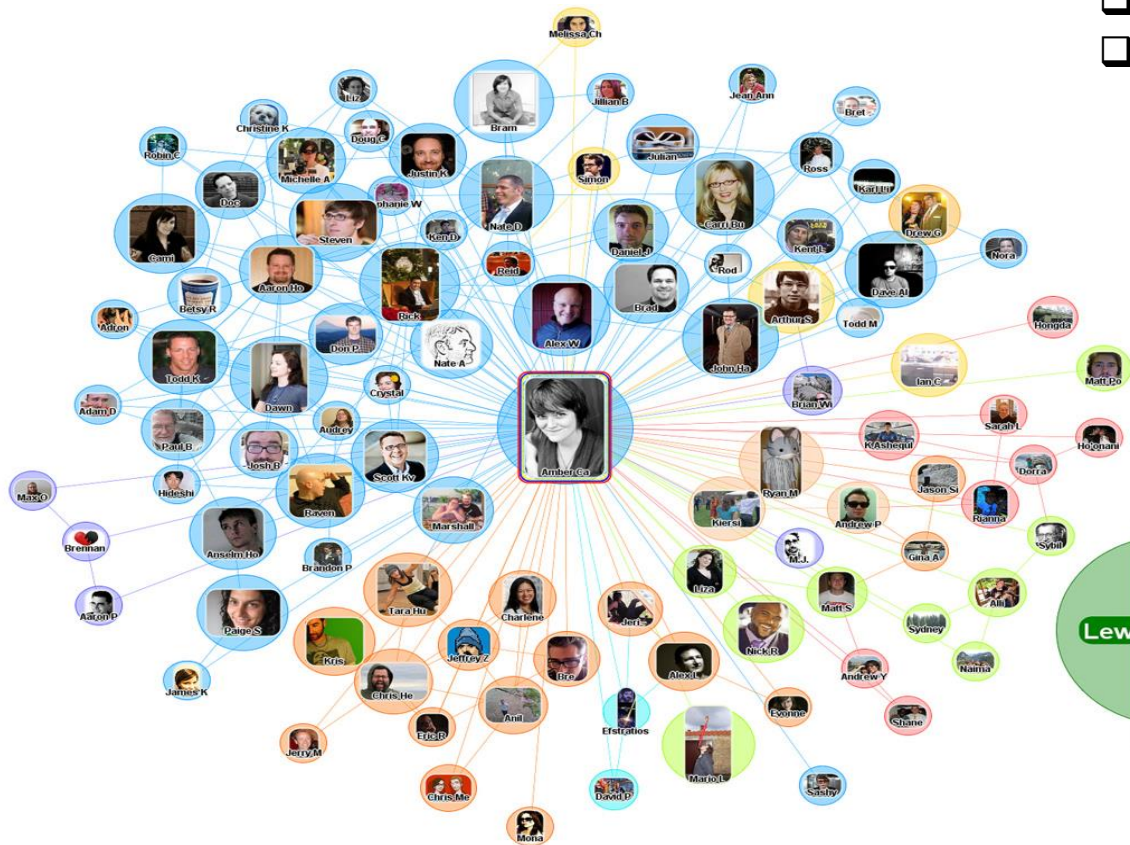
- **Networks** are everywhere, and we live in a highly-connected world.
- **Social Network**

*A **social network** is a **social structure** made up of a set of **social actors** (such as individuals or organizations), sets of dyadic ties, and other **social interactions** between actors.*

-- wikipedia



Social Networks – Facebook ego-network



- ☐ Find your communities
- ☐ Know how to approach a person via Facebook.
e.g., how to increase the chance of getting your friend invitation accepted?

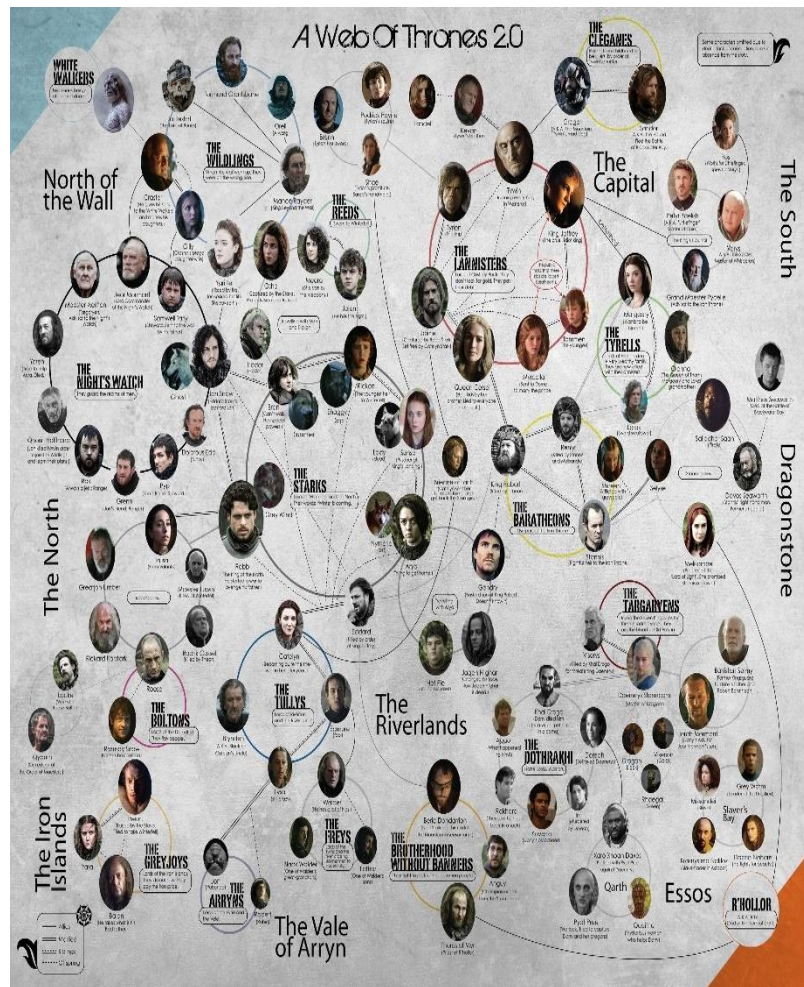
Social Networks – Facebook

Monthly active users: around **1 billion** in **2012** and now around **1.86 billion** (Google+ : 440 million)

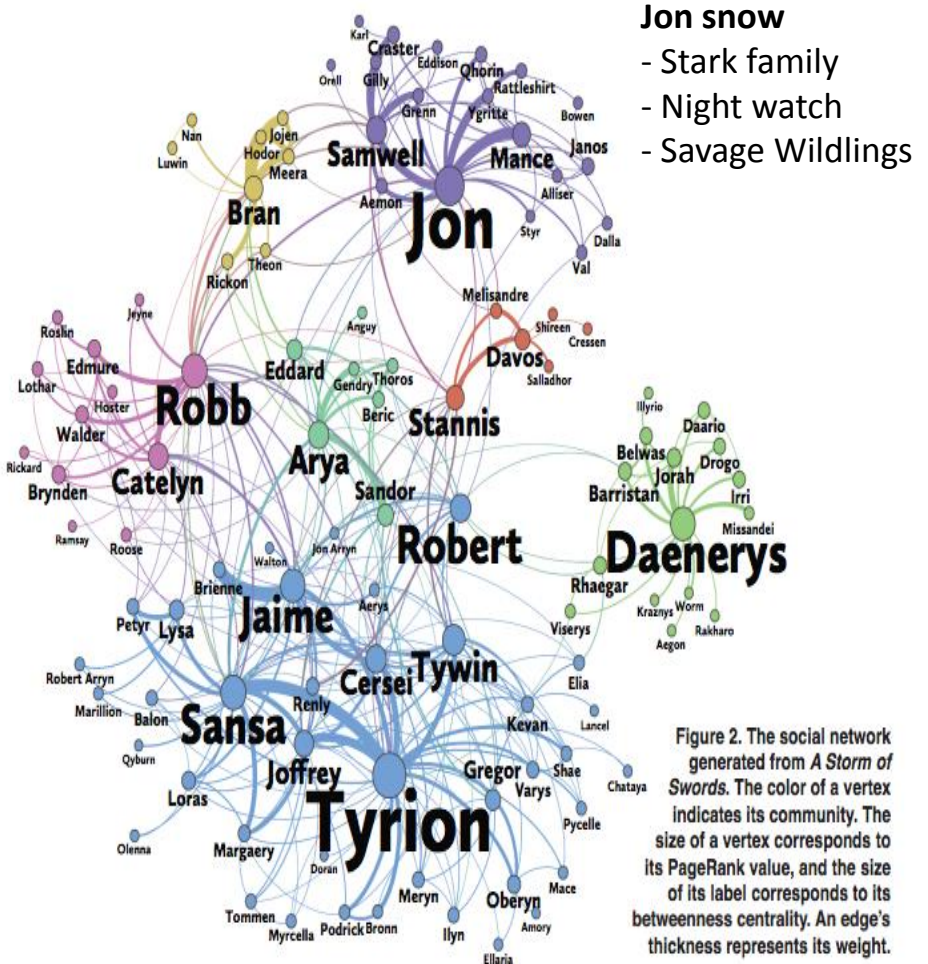


Facebook social graph, 4-degrees of separation [Backstrom-Boldi-Rosa-Ugander-Vigna, 2011]

Social Networks – Network of thrones



<http://www.chartgeek.com/game-of-thrones-family-tree/>

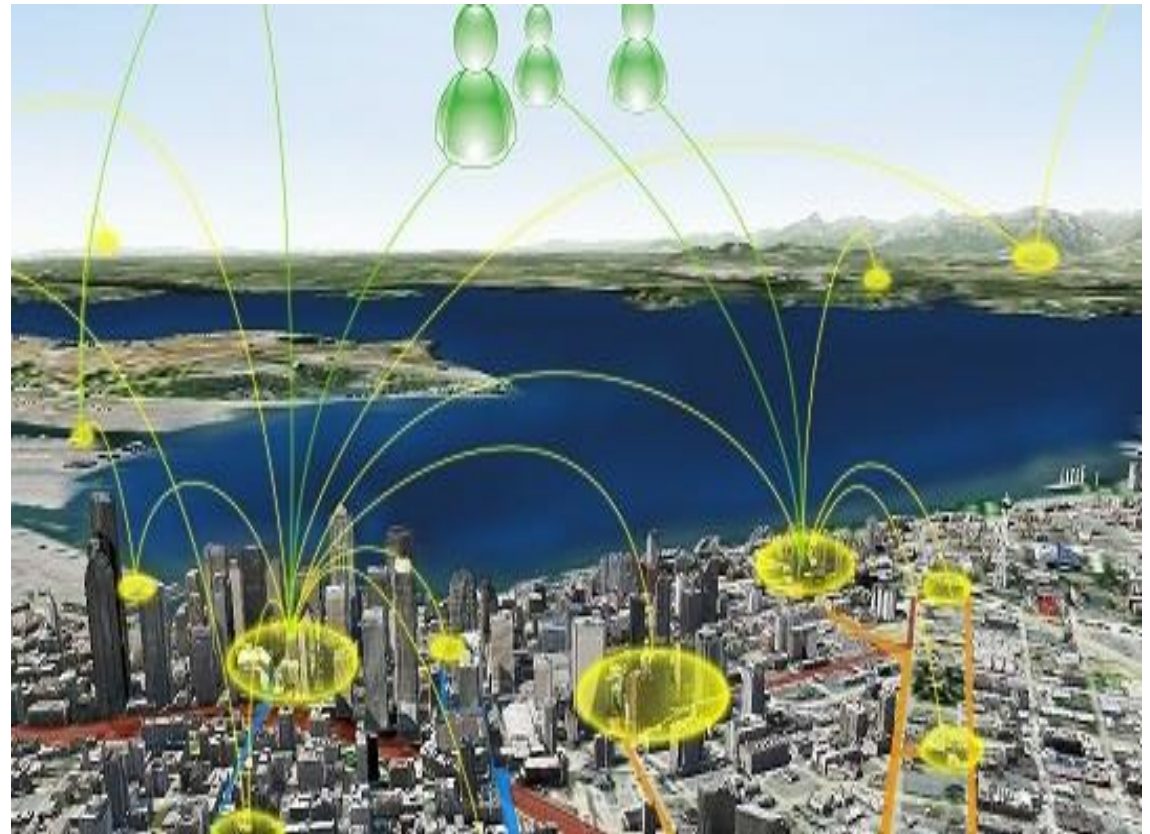


<http://www.maa.org/sites/default/files/pdf/Mathhorizons/NetworkofThrones%20%281%29.pdf>

Social Networks – Location Based Social Network (LBSN)



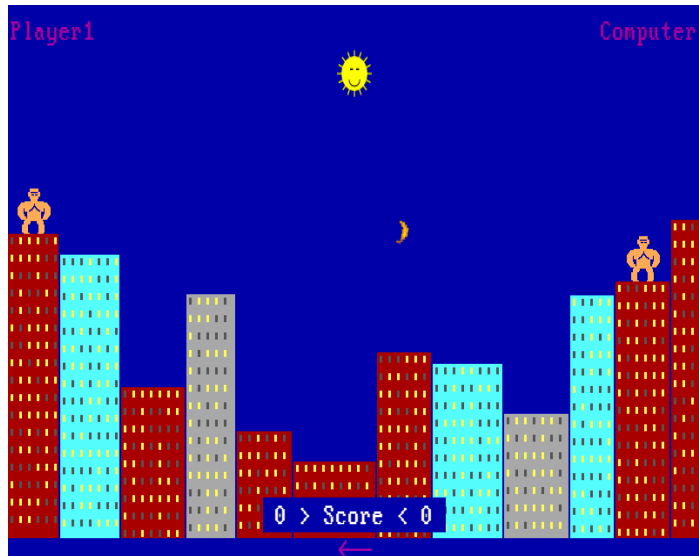
20 Hot Location-Based Apps and Services
You Should Know About



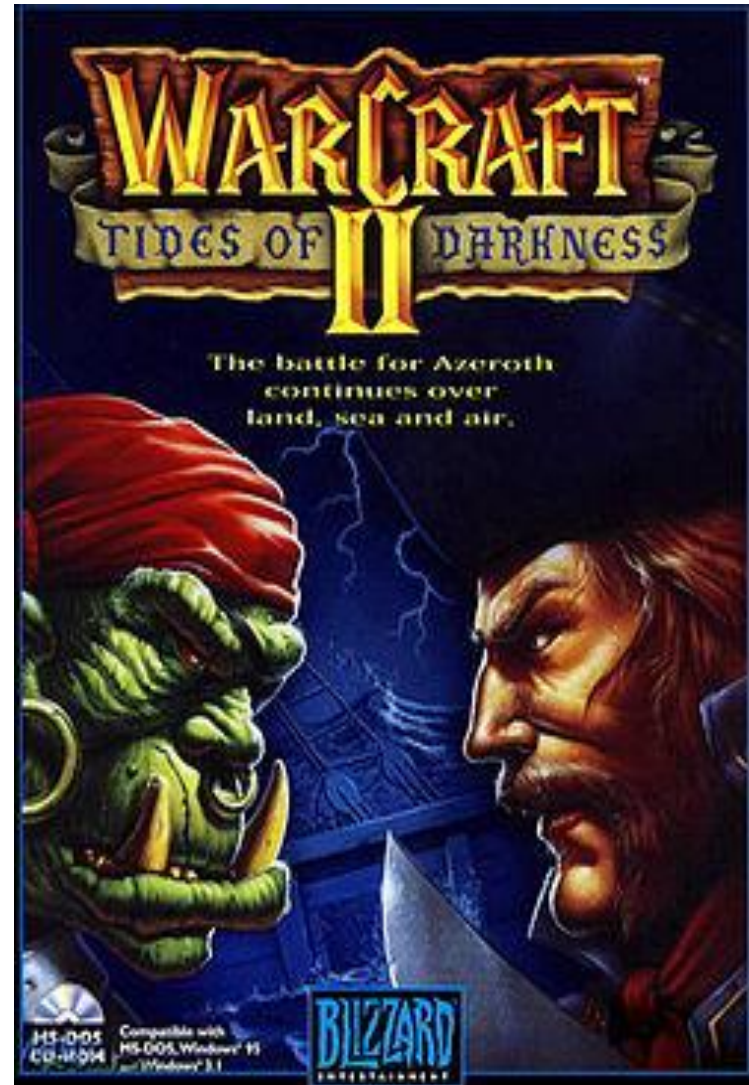
<https://www.microsoft.com/en-us/research/project/location-based-social-networks>

Yelp data challenge !

Social Networks – Social Games

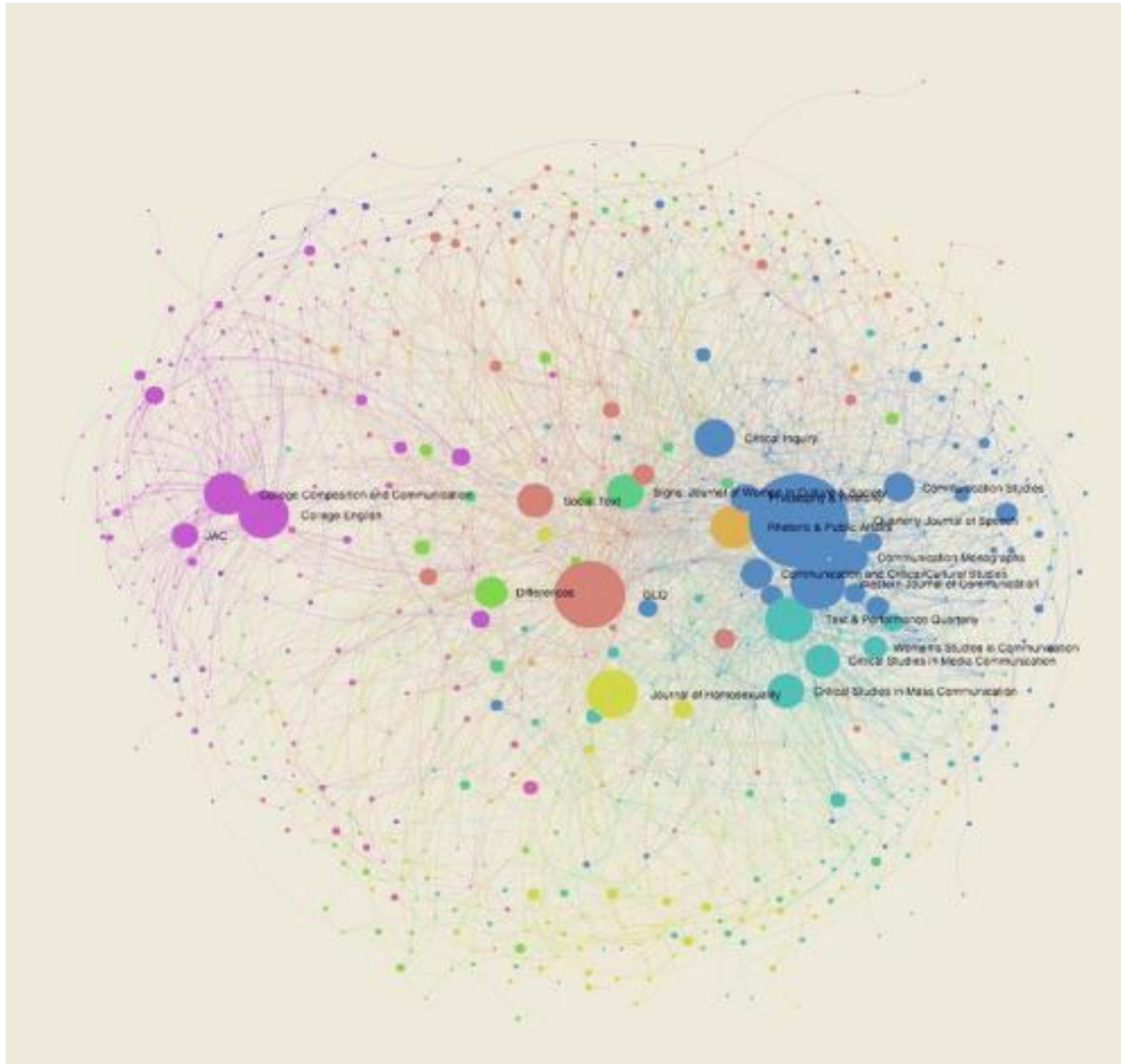


Hit your opponent with an exploding banana.



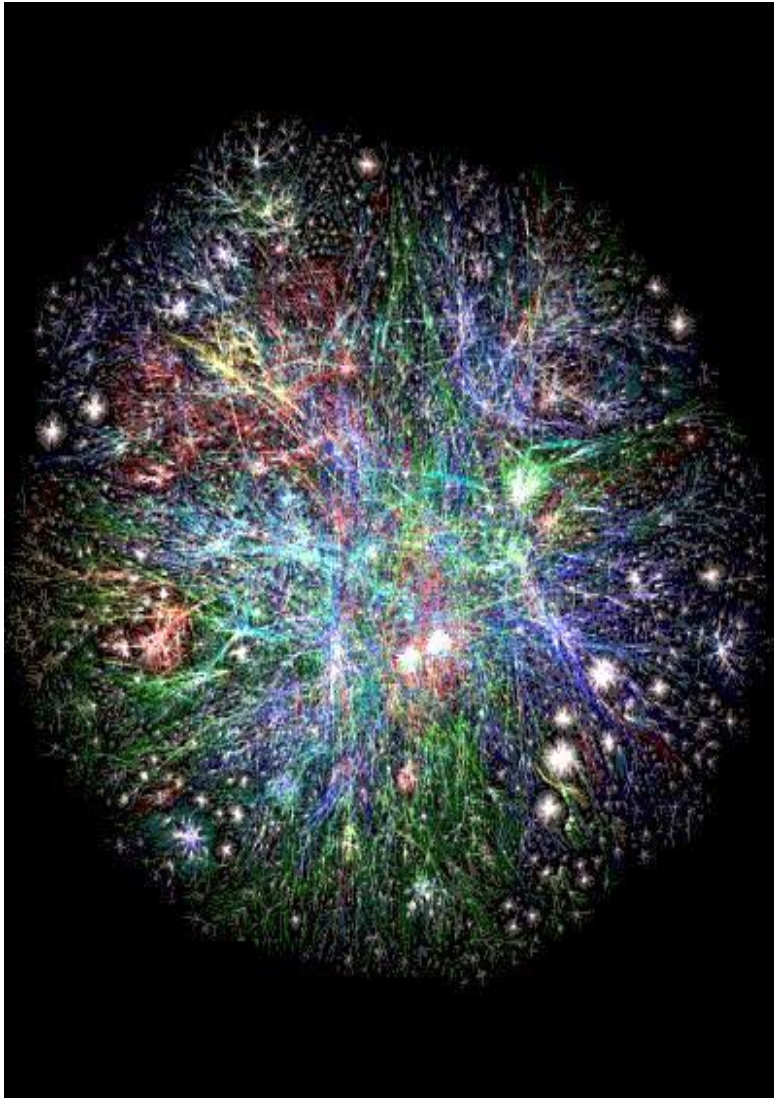
Social Networks – Citation network

Citation Network is a social network which contains paper sources and linked by co-citation relationships



<http://michaeljfaris.com/blog/2015/08/2353652015-visualizing-citation-networks/>

Information Networks – WWW

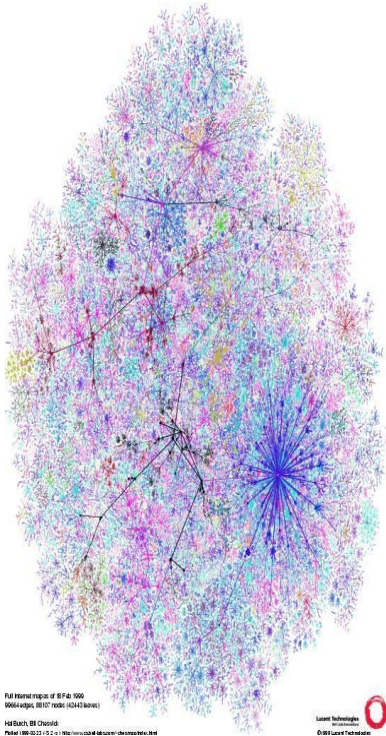


3D Map of the World Wide Web

This illustrates in 3-D the actual domains and connections of the world wide web. **Colors** have been added to represent .edu, .gov, .com, etc. domains.

<http://www.vlib.us/web/worldwideweb3d.html>

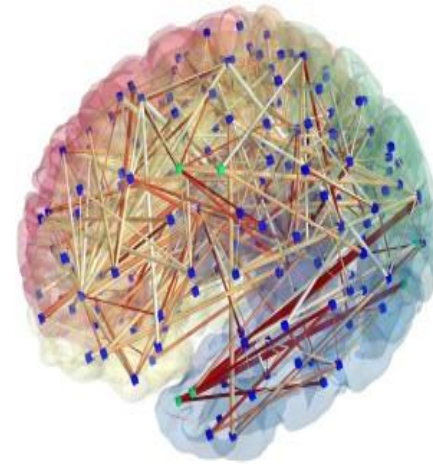
Many other Networks



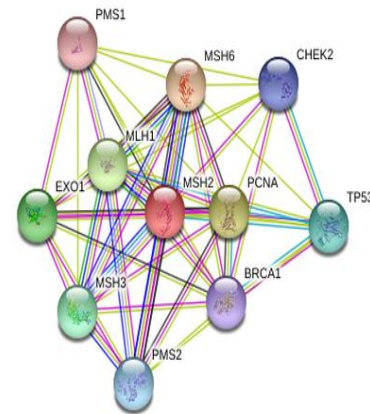
Internet



Sydney Road Network
<http://www.brt.cl/opinion-pieces-i-tolled-you-so>

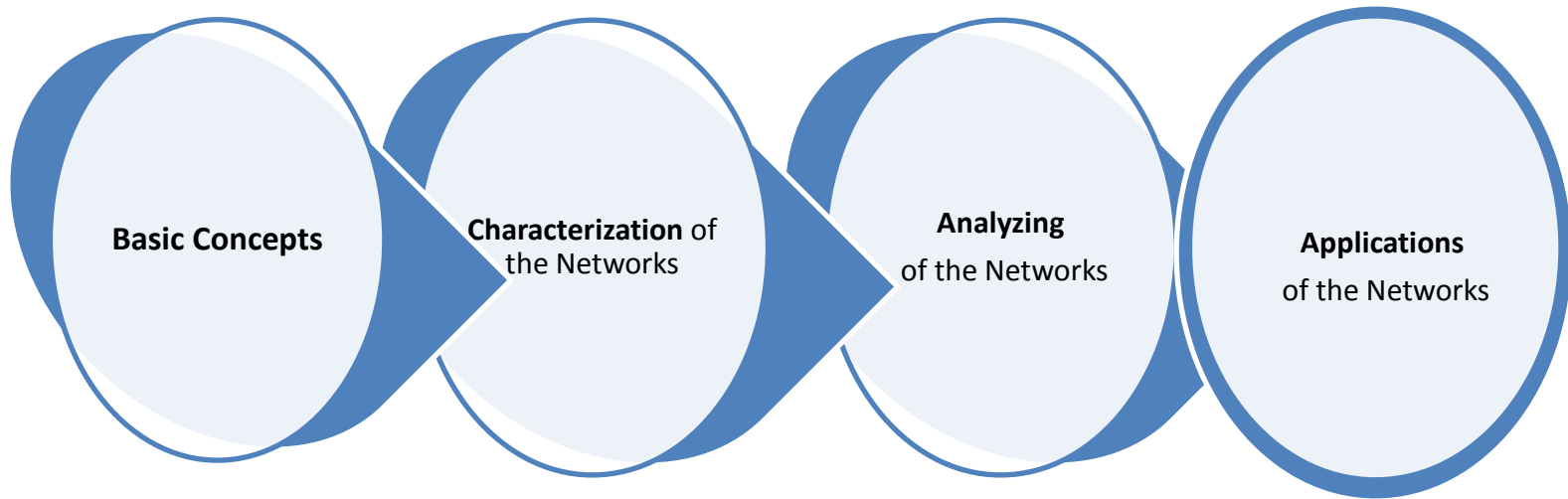


Human Brain Network (10-100 billion neurons)
<http://blog.mysr.org/mri-reveals-the-human-connectome>



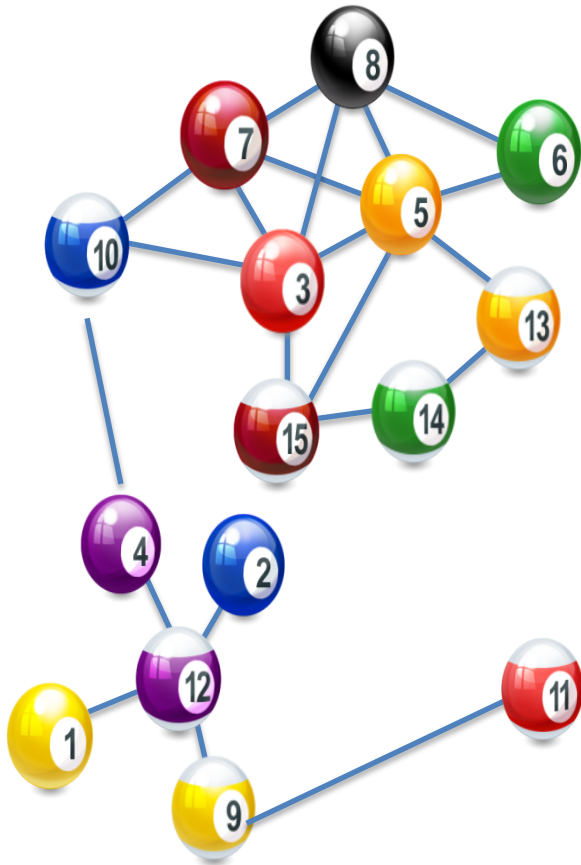
Protein interaction network

Social Network Analysis



- ☐ What are networks? **Basic concepts**
- ☐ How to **characterize** networks?
- ☐ How to **analyse** social and information network data?
 - Methods and tools;
- ☐ **Applications** of social and information network analysis

CHARACTERIZATION



- **Degree**: how many friends do I have?
- **Weights**: how strong are the ties?
- **Path**: how far am I from another vertex?
- **Connectivity**: can I reach all other vertices?
- **Diameter**: how dense are they?
- **Centrality** (e.g., betweenness, closeness): Am I in the center of everyone?

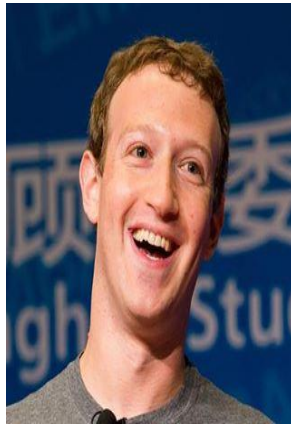
Average shortest path

How close is everyone from everyone?

Six degree of separation: only six hops separate any two people in the world

“Three and a half degrees of separation” recently reported by Facebook research

<https://research.fb.com/three-and-a-half-degrees-of-separation/>



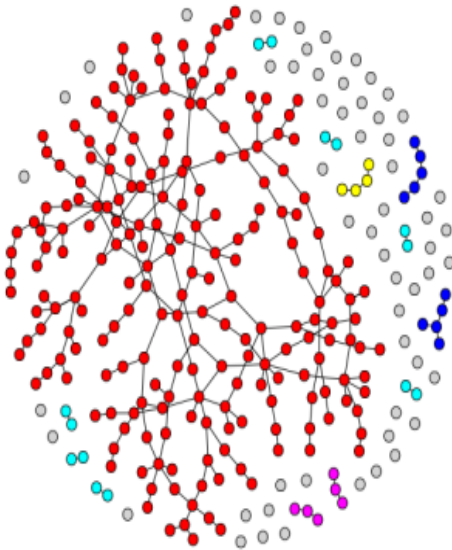
Mark Zuckerberg

3.17 degrees of
separation

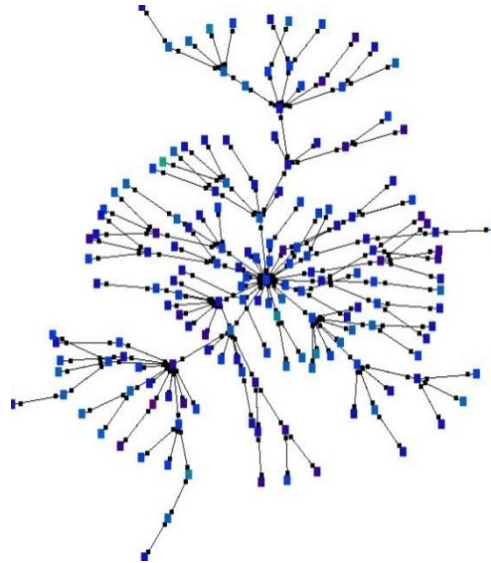
Graph Modelling

Network modelling is to find the **right generative process** of networks that **explains the observations** of network properties.

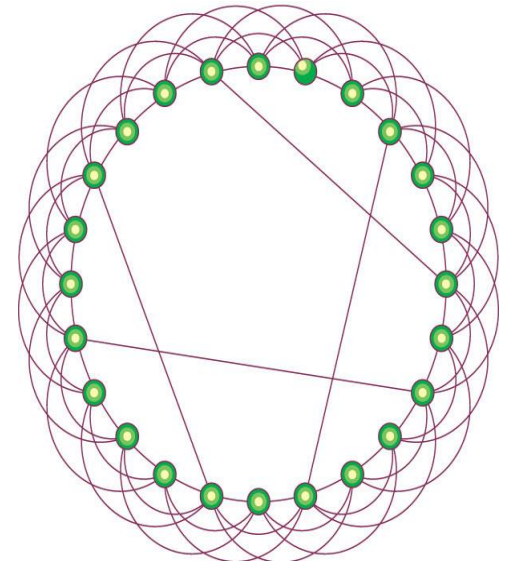
- Degree distribution, average shortest path, community structure, etc.



Random graph



Scale-free graph



Small world graph

Search

- Find the (shortest) path between two people.



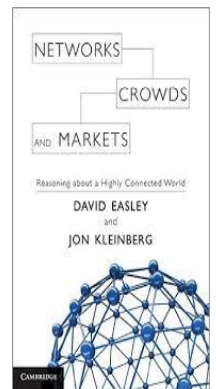
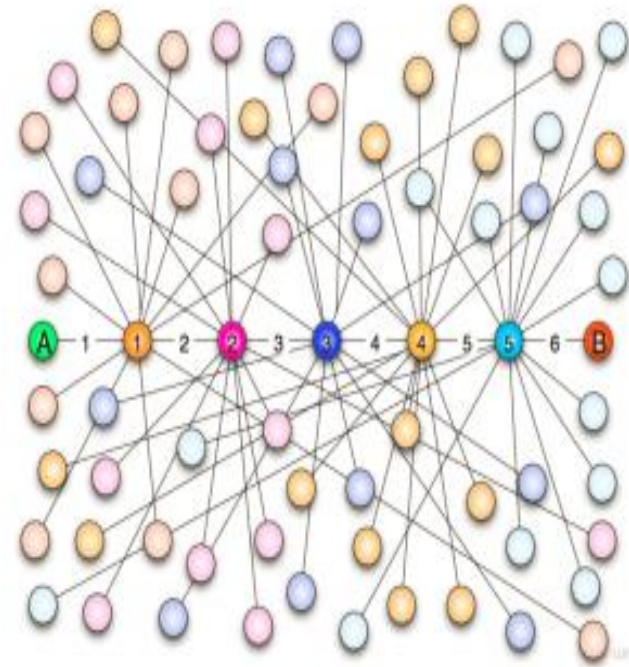
Wenjie Zhang



Ming Hua
(manager at Facebook)

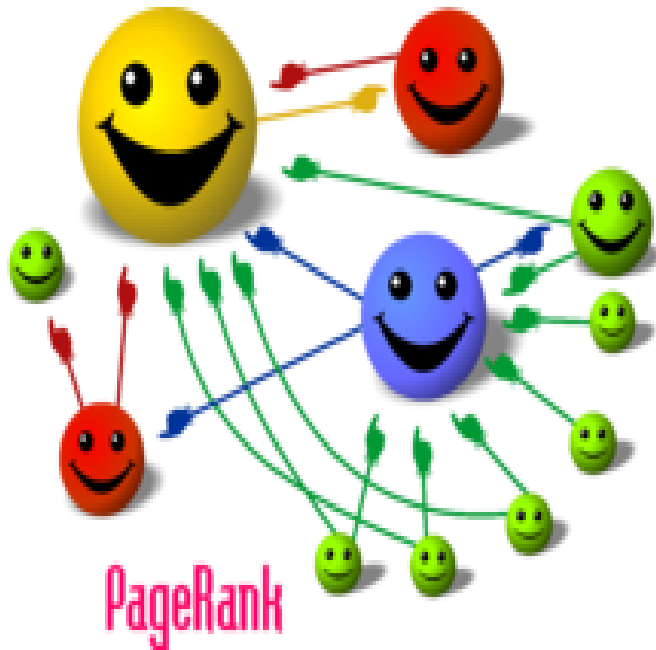


Mark Zuckerberg

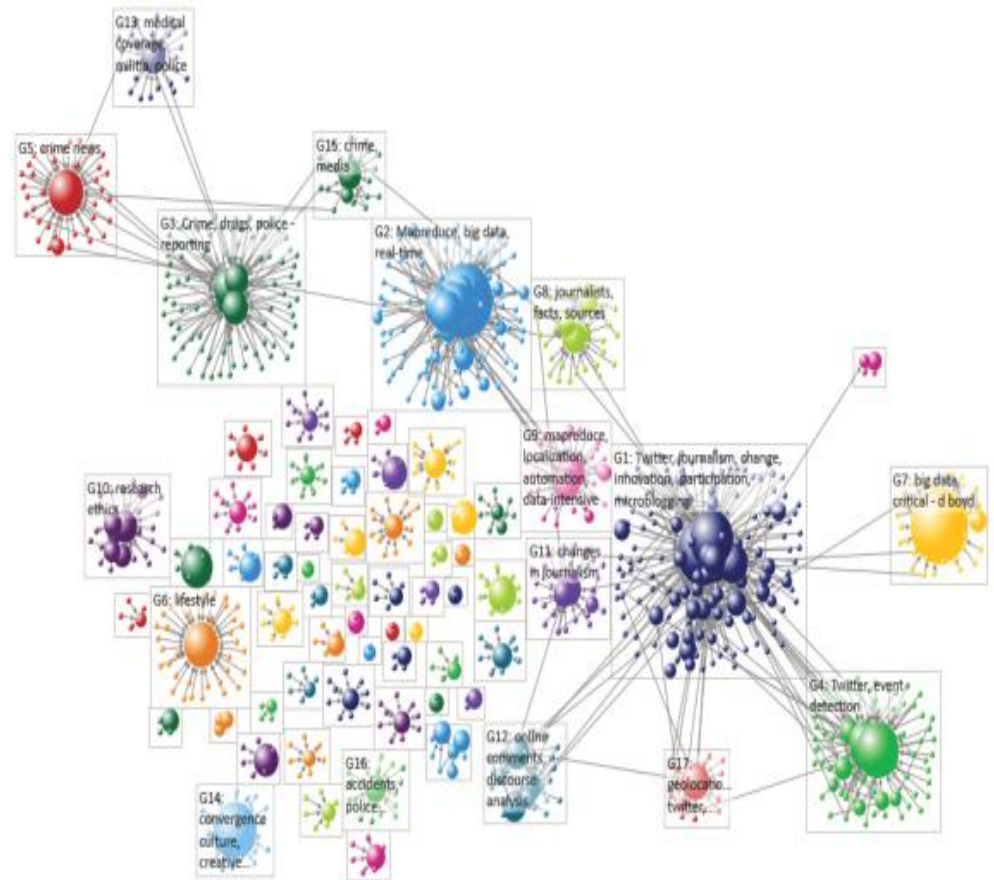


Ranking

- Importance of the vertices. E.g., which is the most influential paper in a co-citation network



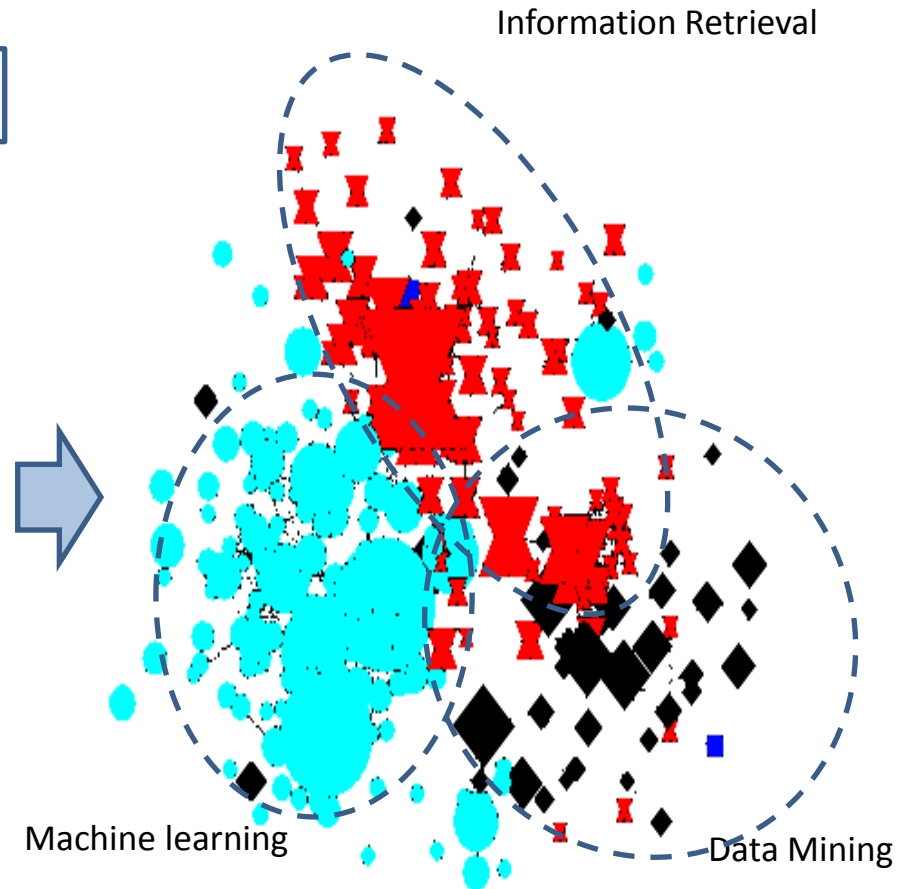
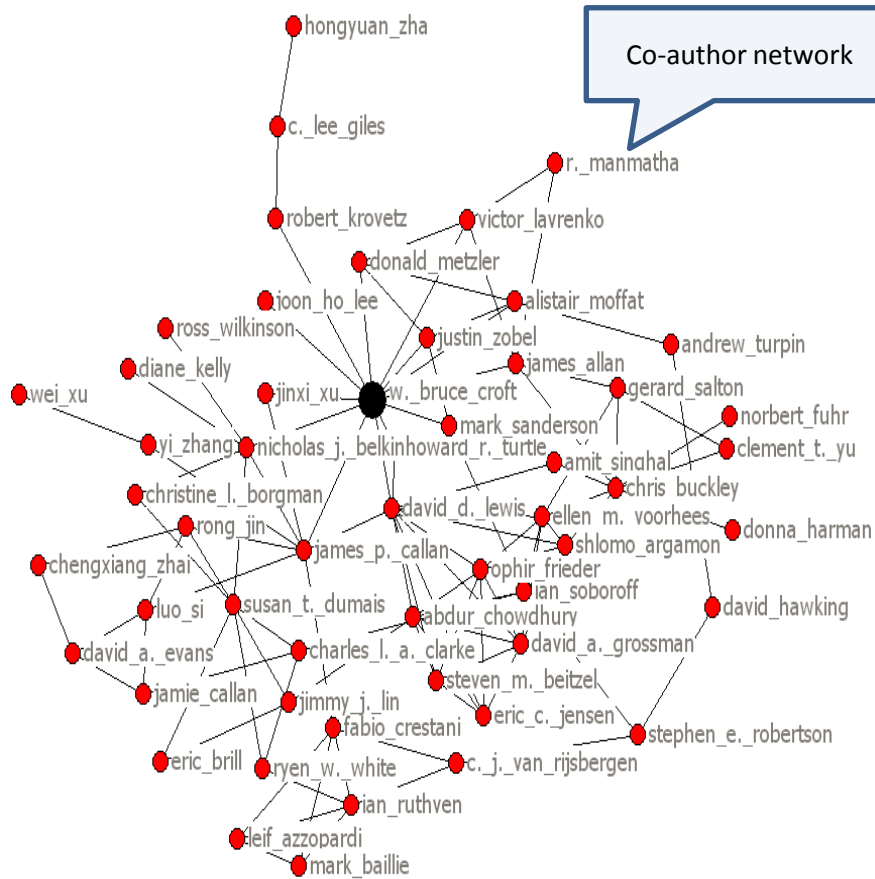
<https://en.wikipedia.org/wiki/PageRank>



<https://www.researchgate.net/>

Finding Communities

□ Who tend to work together



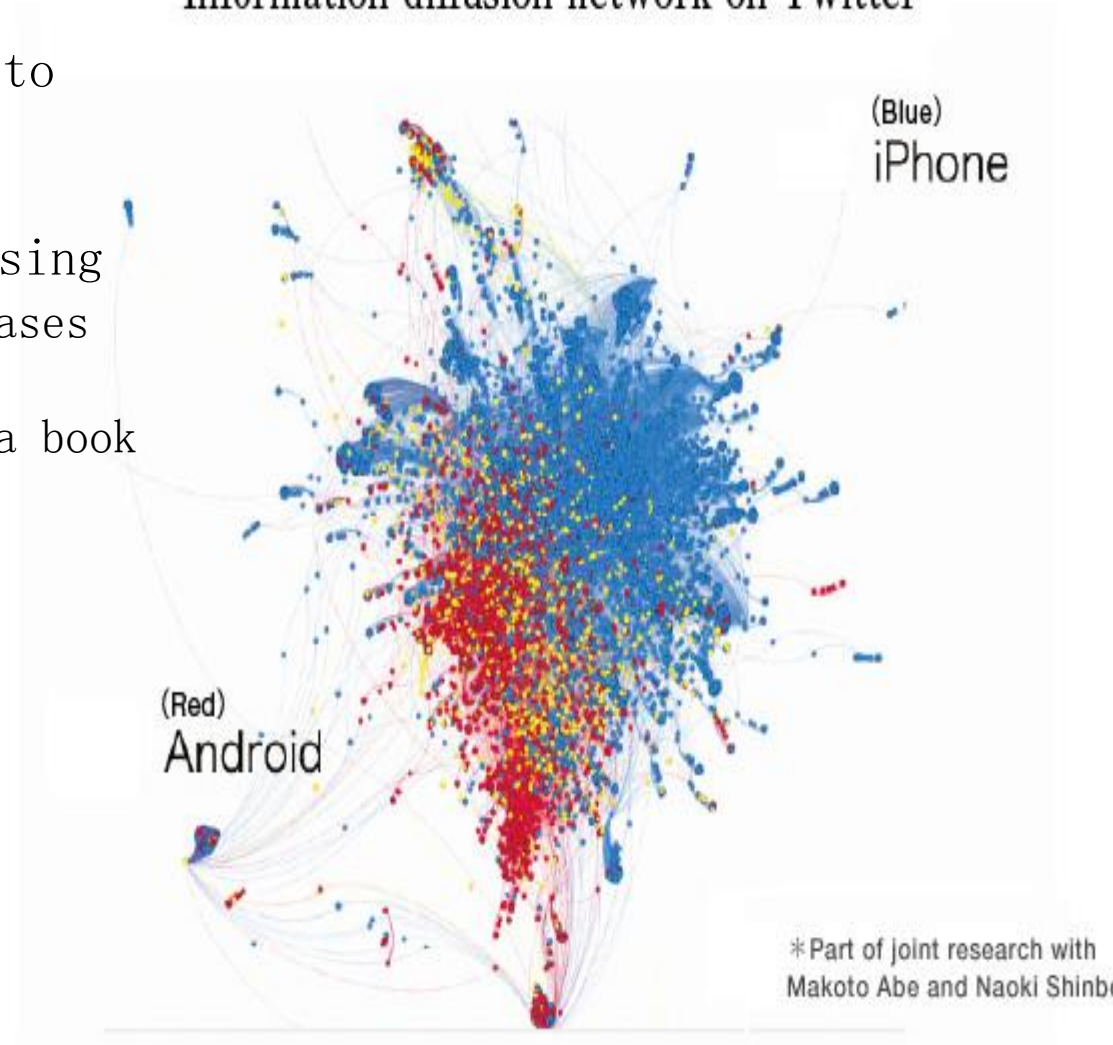
Network Dynamic Analysis

Information diffusion network on Twitter

Cascade behaviour from node to node like an epidemic

E. g. ,

- Marketing, online advertising
- News, opinions, rumors, diseases
- Adoption of innovation;
- Joining a community, buying a book



Network Dynamic Analysis

Our survey: around 50% used to play, now no active user any more

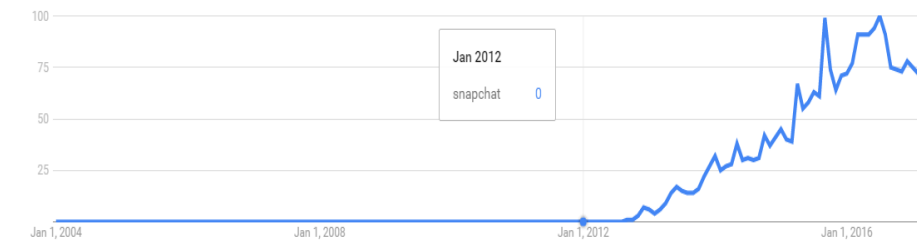
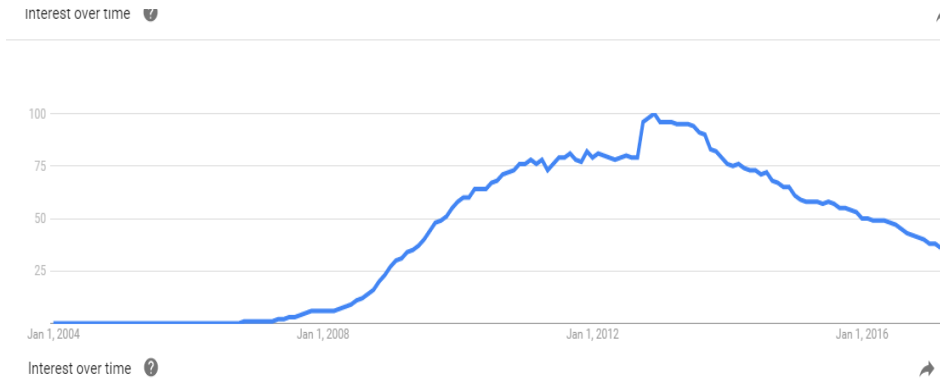
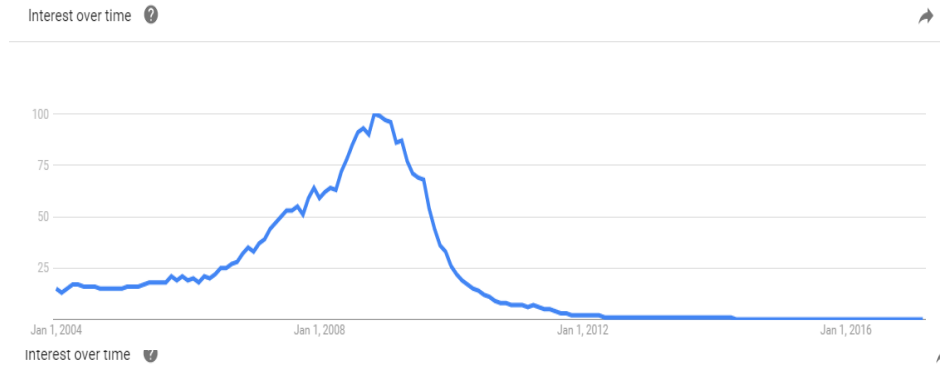


Interest over time ?



Google Trend "Pokémon Go"

Network Dynamic Analysis

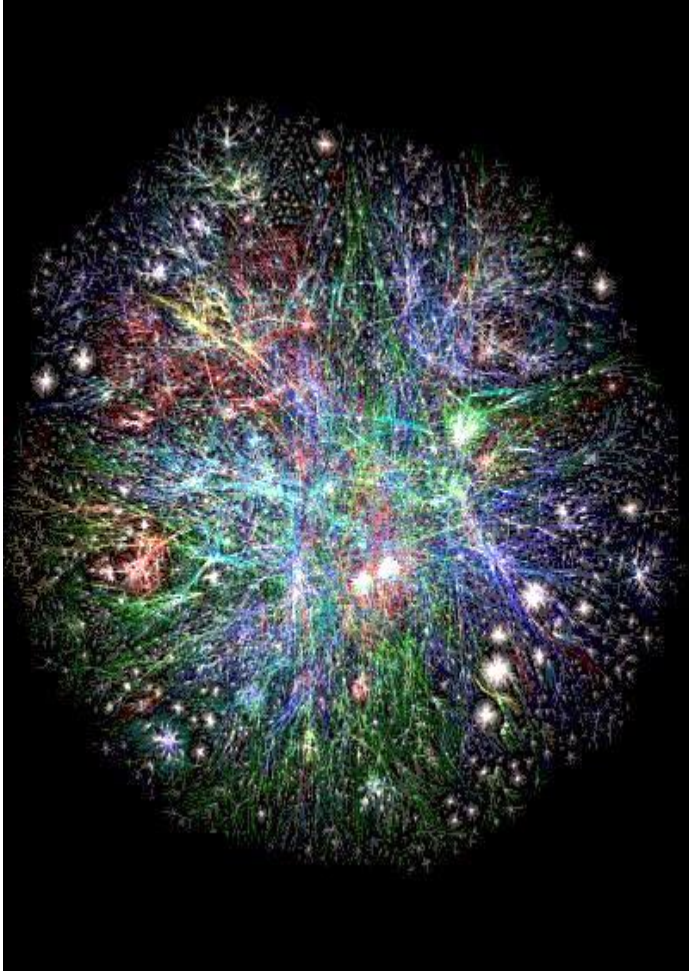


Google trend for

**Friendster,
Facebook and
Snapchat**

Since 2004

Web search



❑ Understand the user intent

*"Please translate these roman numerals
mcmxcviii thank you."*

❑ Find the **relevant** webpages
(relevance)

❑ **Rank** the search results (by
importance)

Social search

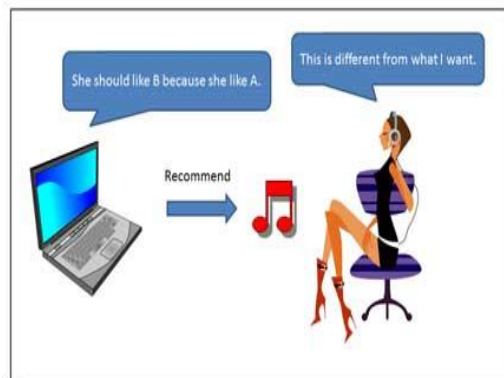
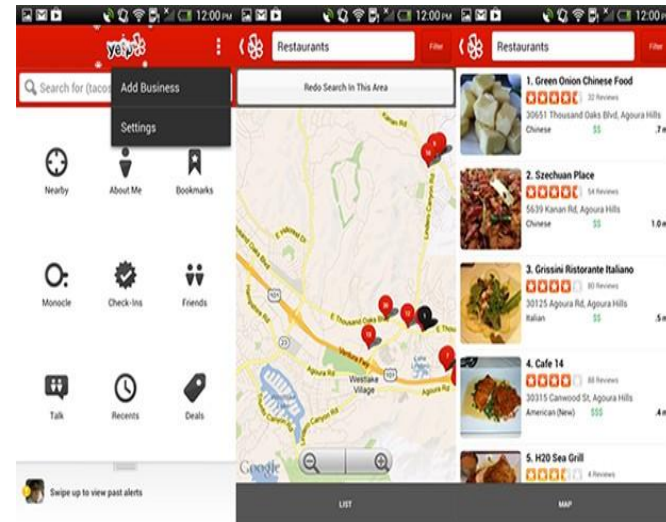
Social Search is an enhanced version of web search, also takes into account **social relationships** between the results and the searcher, such as *work for the same companies, belong to the same social groups* etc.



Facebook graph search



Recommendation



http://www.kis.kansai-u.ac.jp/res_music_e.html



Many other applications

- ❑ Sentiment analysis (e.g., US presidential election prediction)
- ❑ Social behaviour (pattern) analysis
- ❑ Rumour detection and source detection (Facebook and Twitter)
- ❑ Social network privacy
- ❑ Viral marketing
- ❑ Sponsored search
- ❑ Etc.

George Fletcher