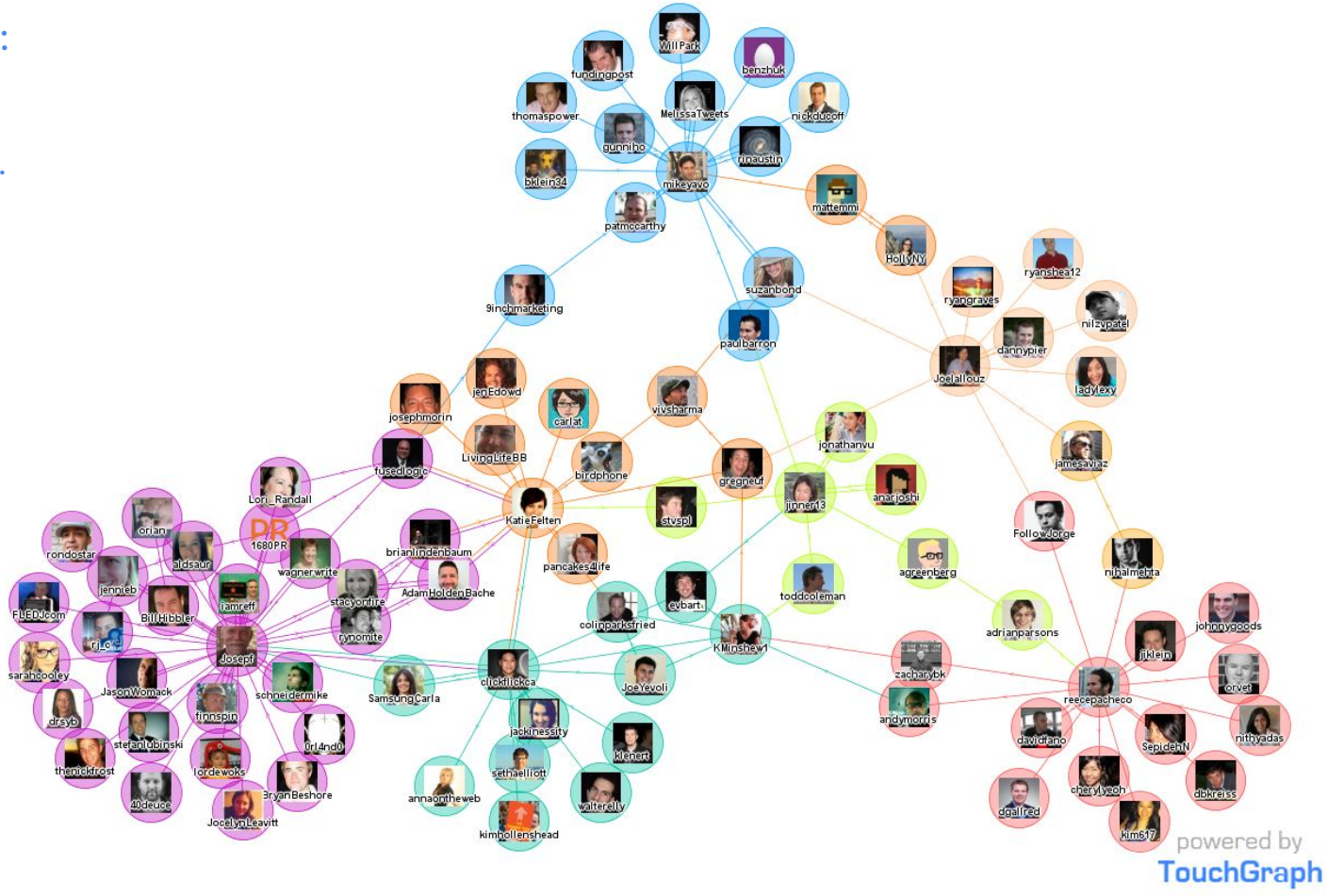
Introduction to complex networks


Networks are everywhere!!!

Social Networks:

- Facebook
- LinkedIn
- Instagram...

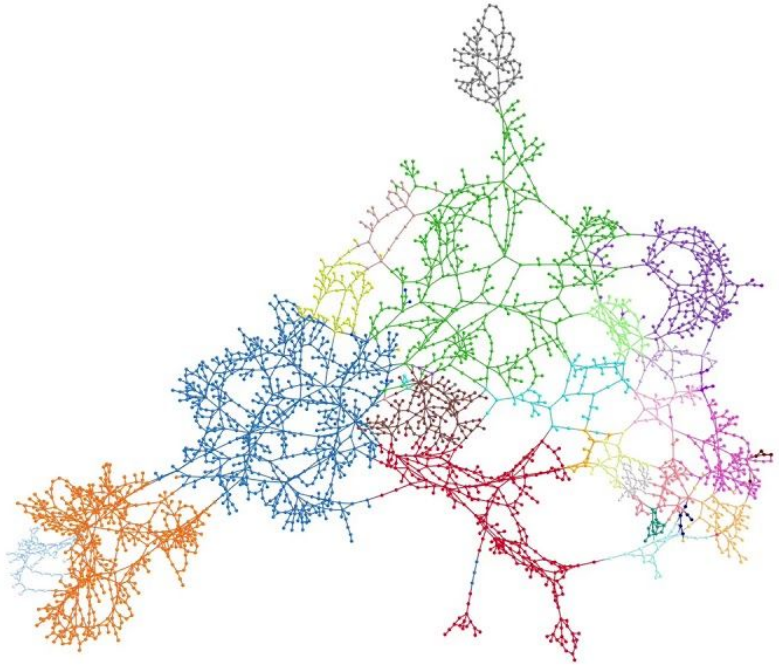


Transportation Networks:

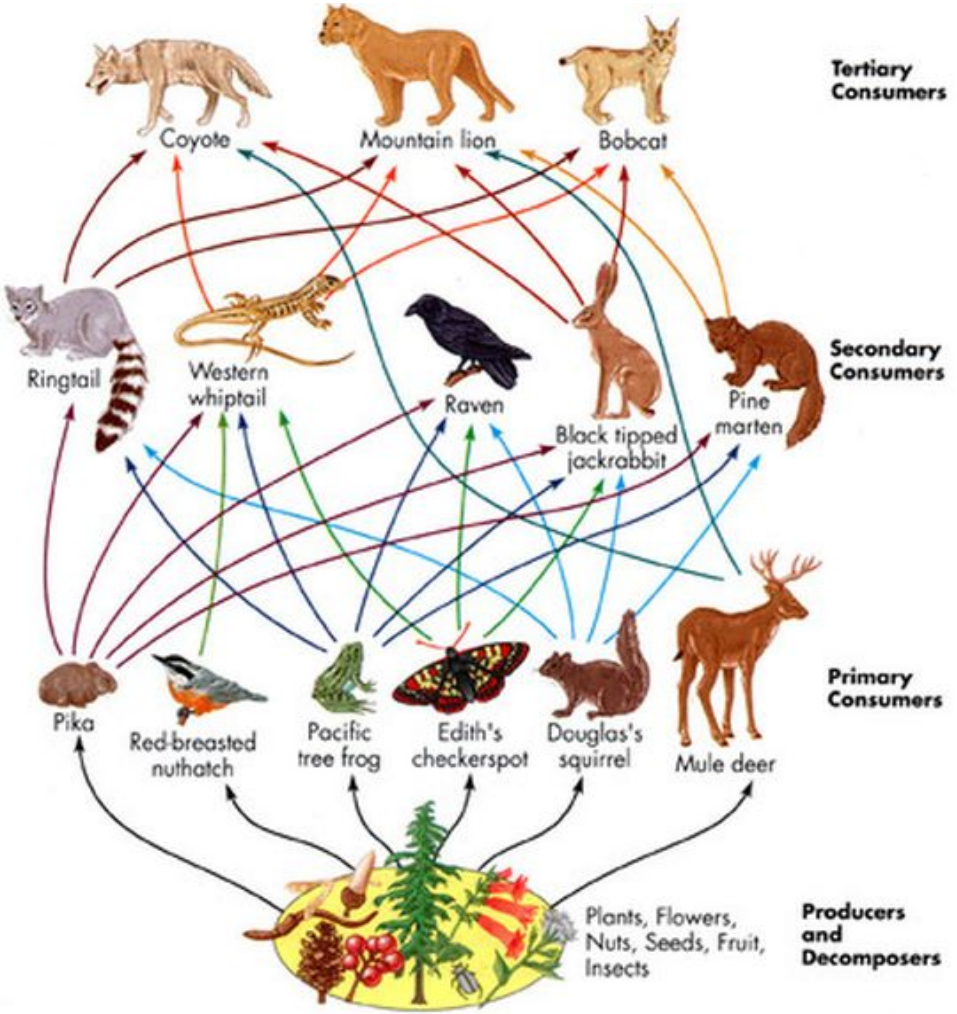
- Metro
- Roads
- Planes...

Power Networks:

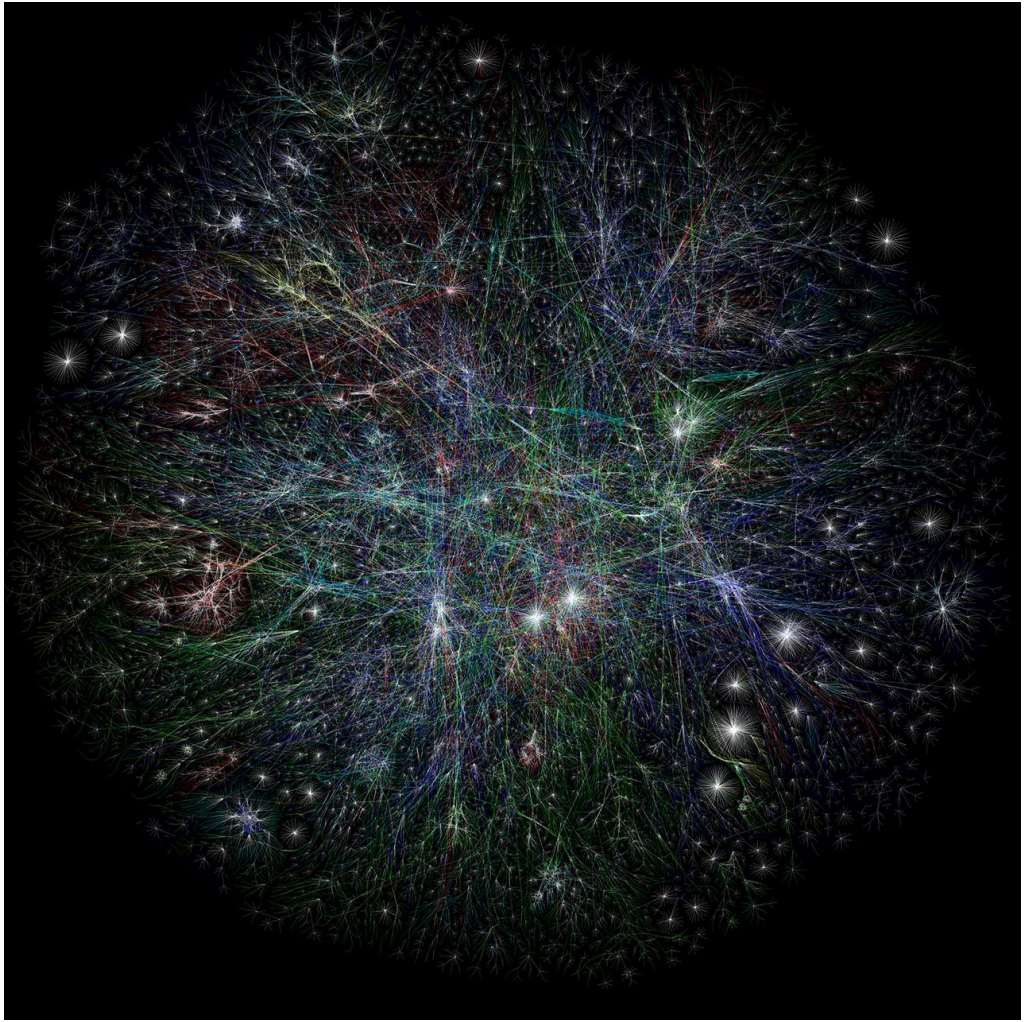
- Electricity
- Roads
- Planes...



Ecological Networks

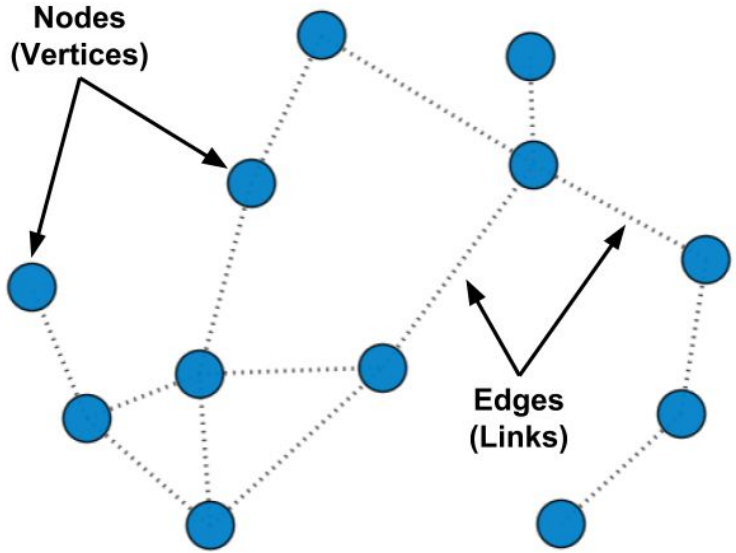


The internet!



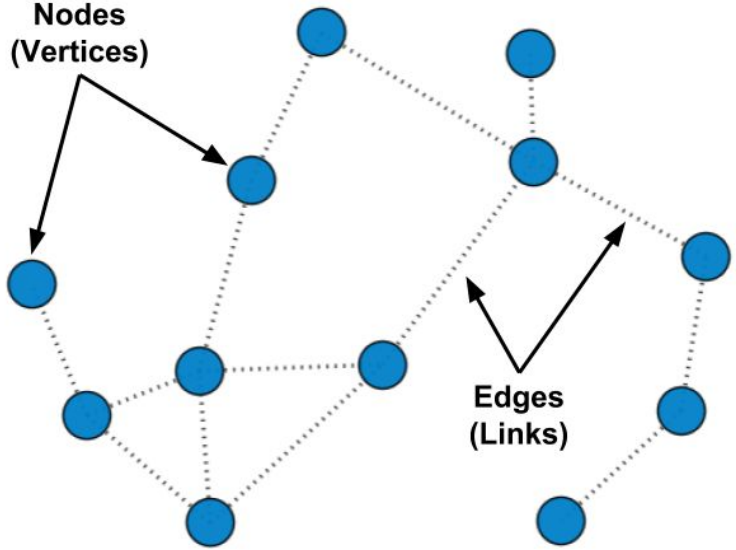
How can we generally describe this objects?

In general we can define a network as **“a set of *nodes* connected by a set of *links*“**



Basic definitions:

- Node
  - Type
- Link
  - Weight
  - Direction



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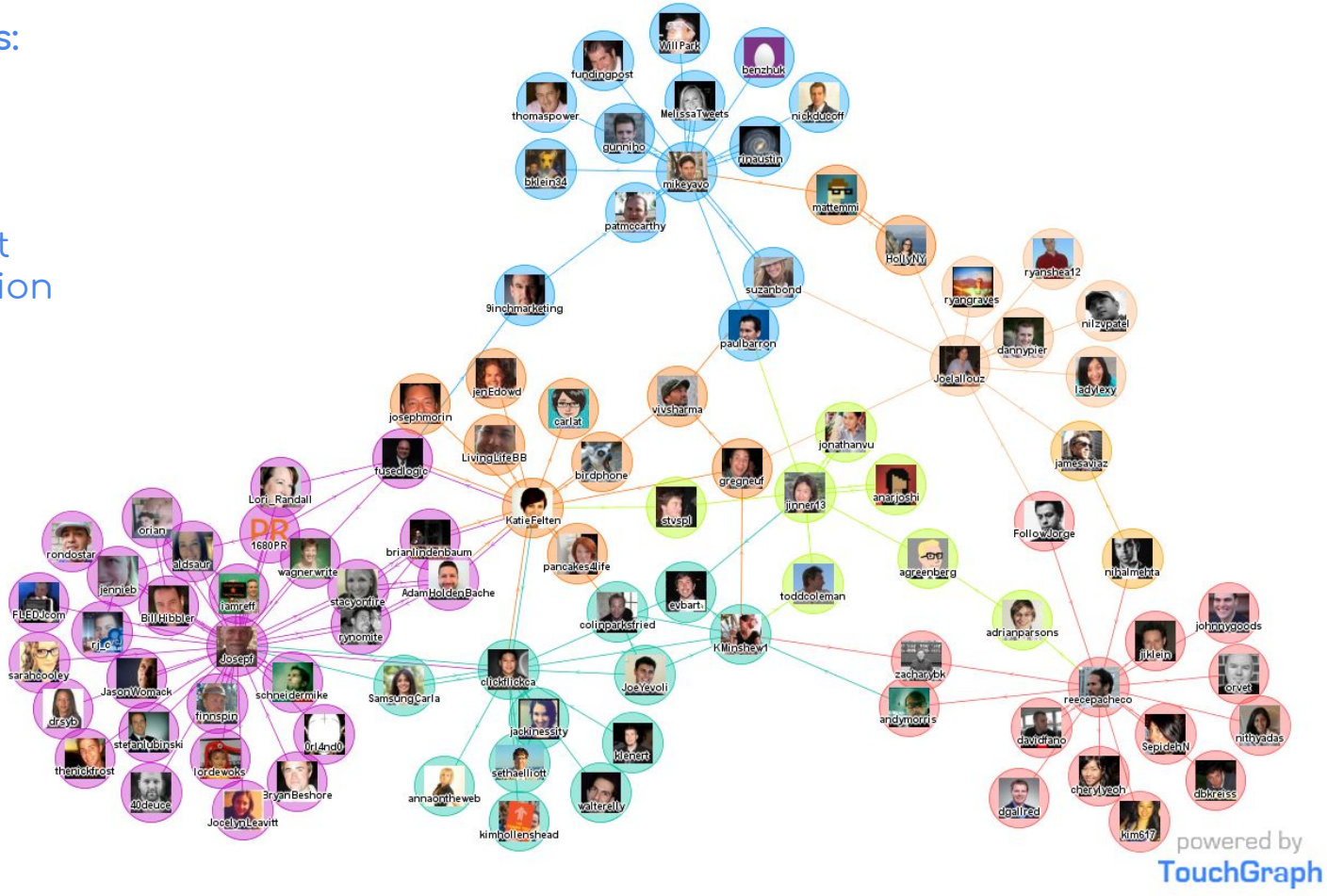

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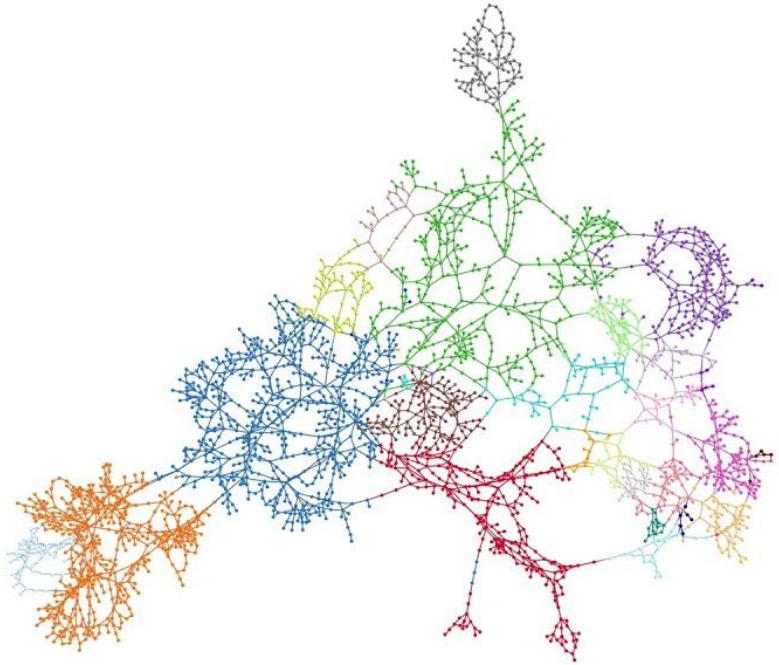

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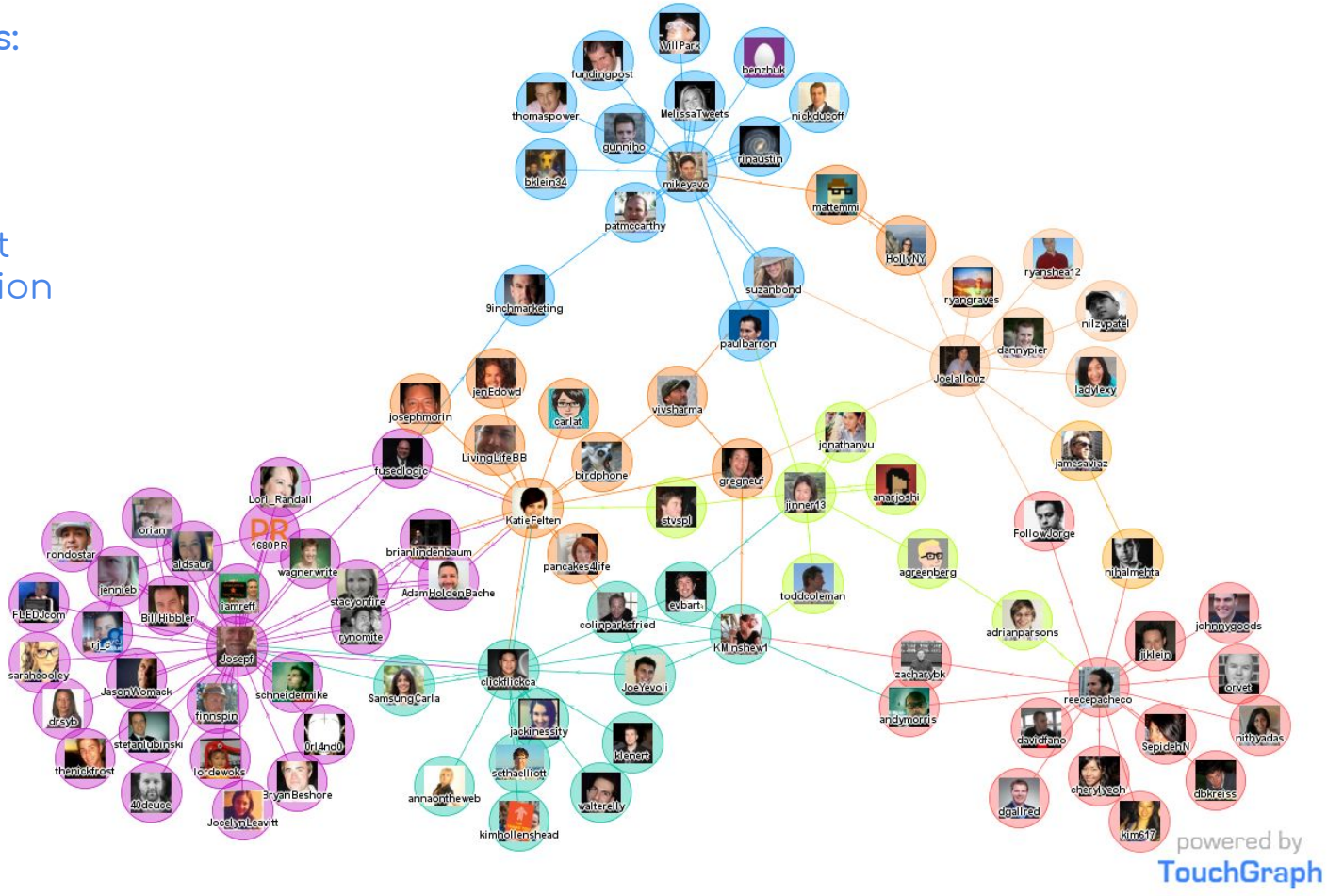


Why are networks so important?

- Vulnerability due to interconnectivity

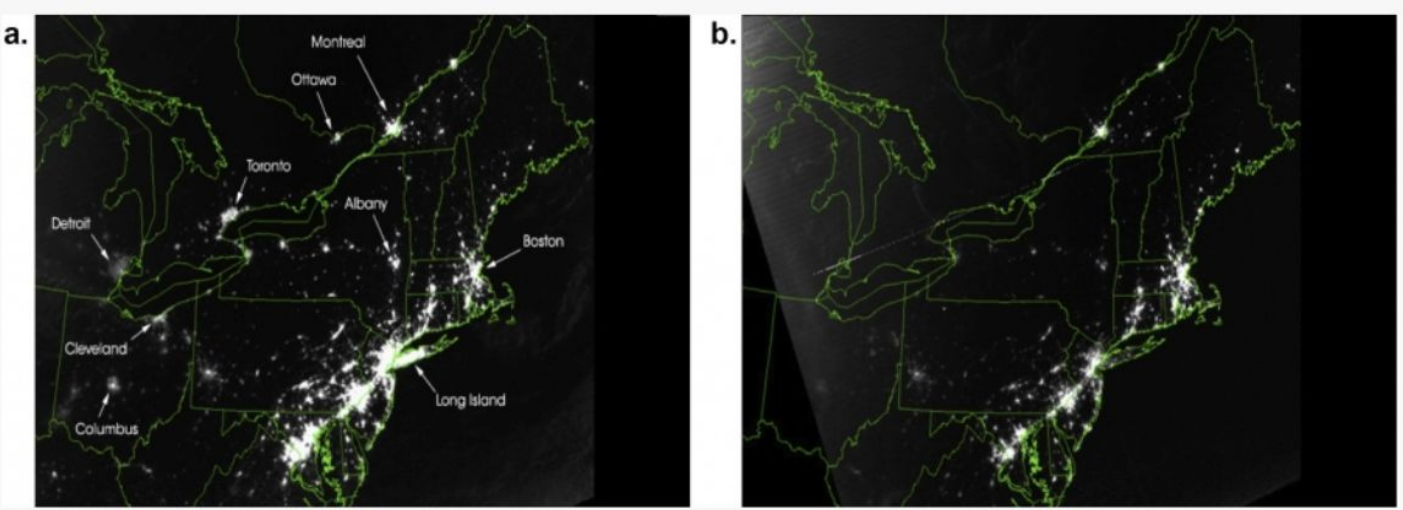
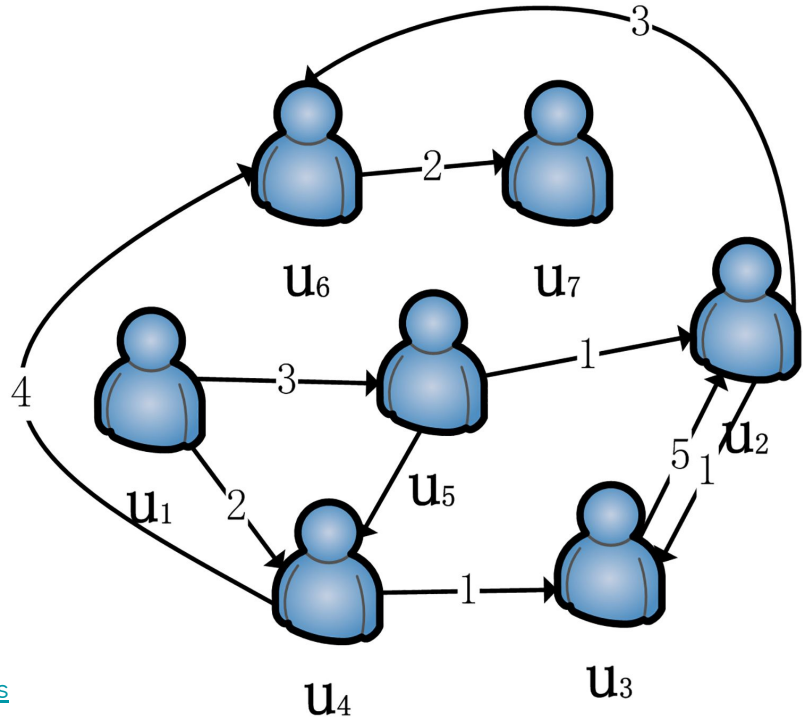


Image 1.1

2003 North American Blackout

Why are networks so important?

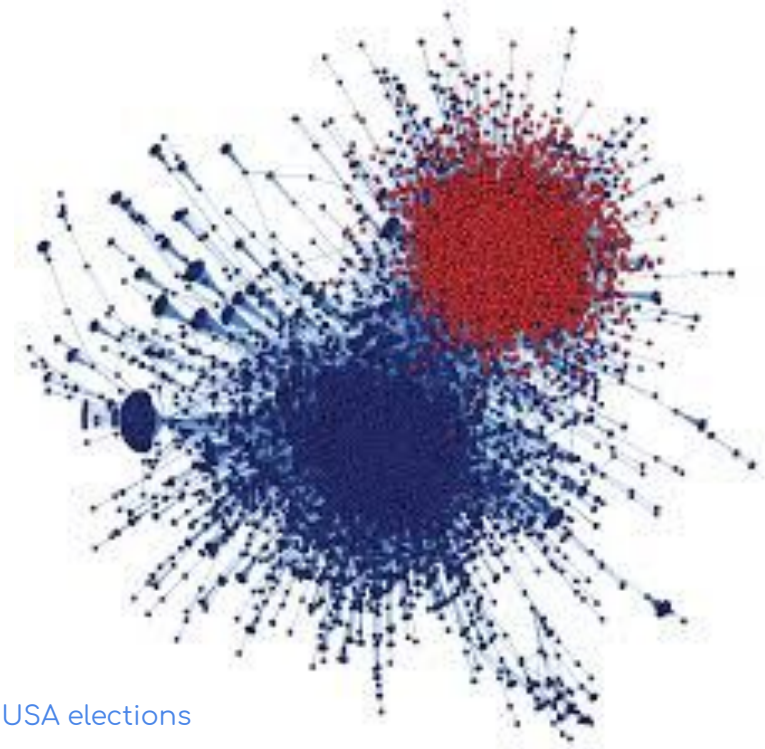
- Friendship recommendation in social networks



See also: [Leaking privacy and shadow profiles in social networks]

Why are networks so important?

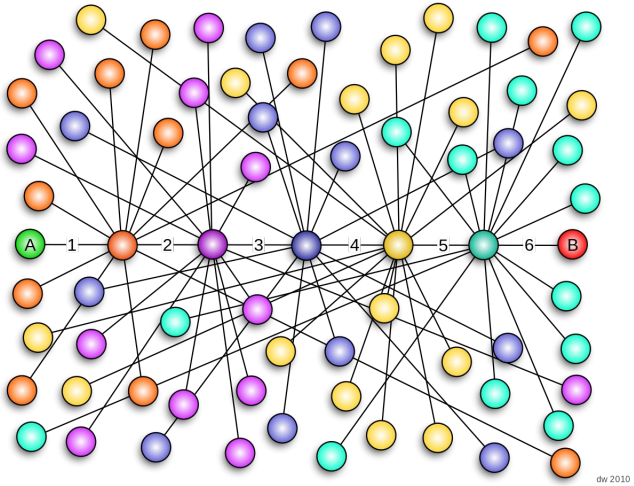
- Political polarization and echo chambers



Political retweet networks in the 2010 USA elections

Why are networks so important?

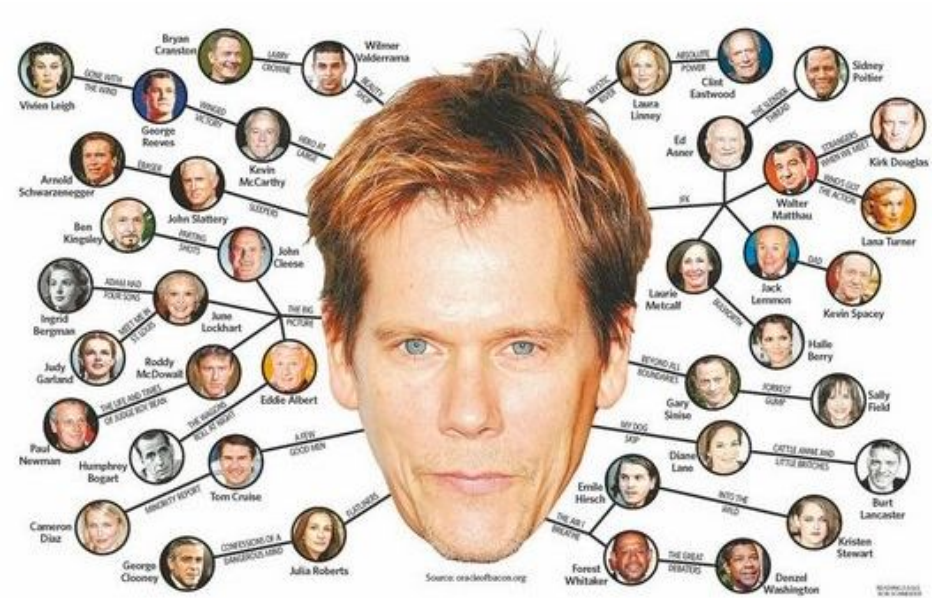
- Explaining the small world effect



Why are networks so important?

- To play the Bacon Game :)

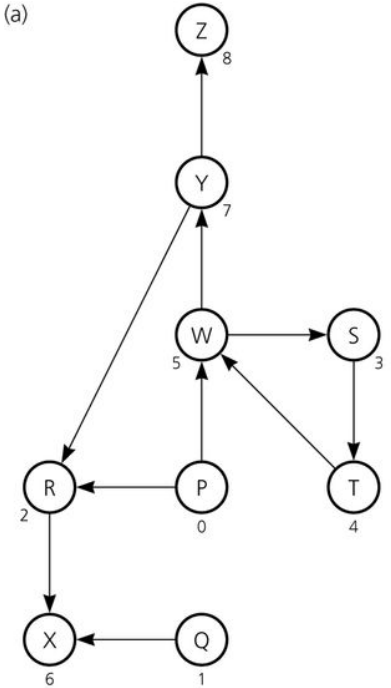
Link to the game



Representing a network:

- Adjacency Matrix
- (also edge lists)

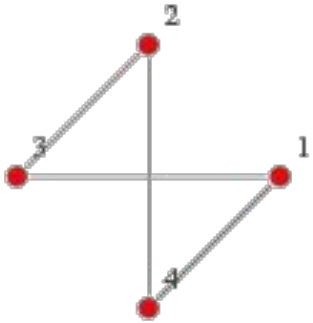
(a)

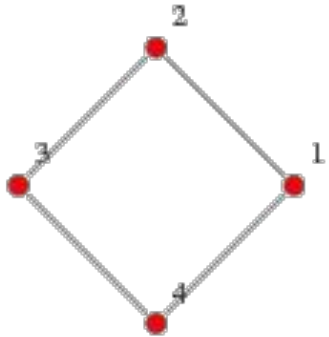


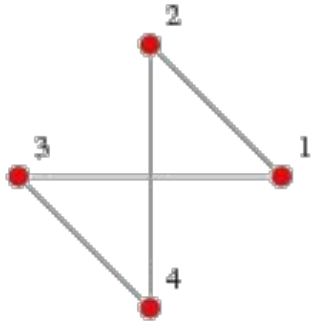
(b)

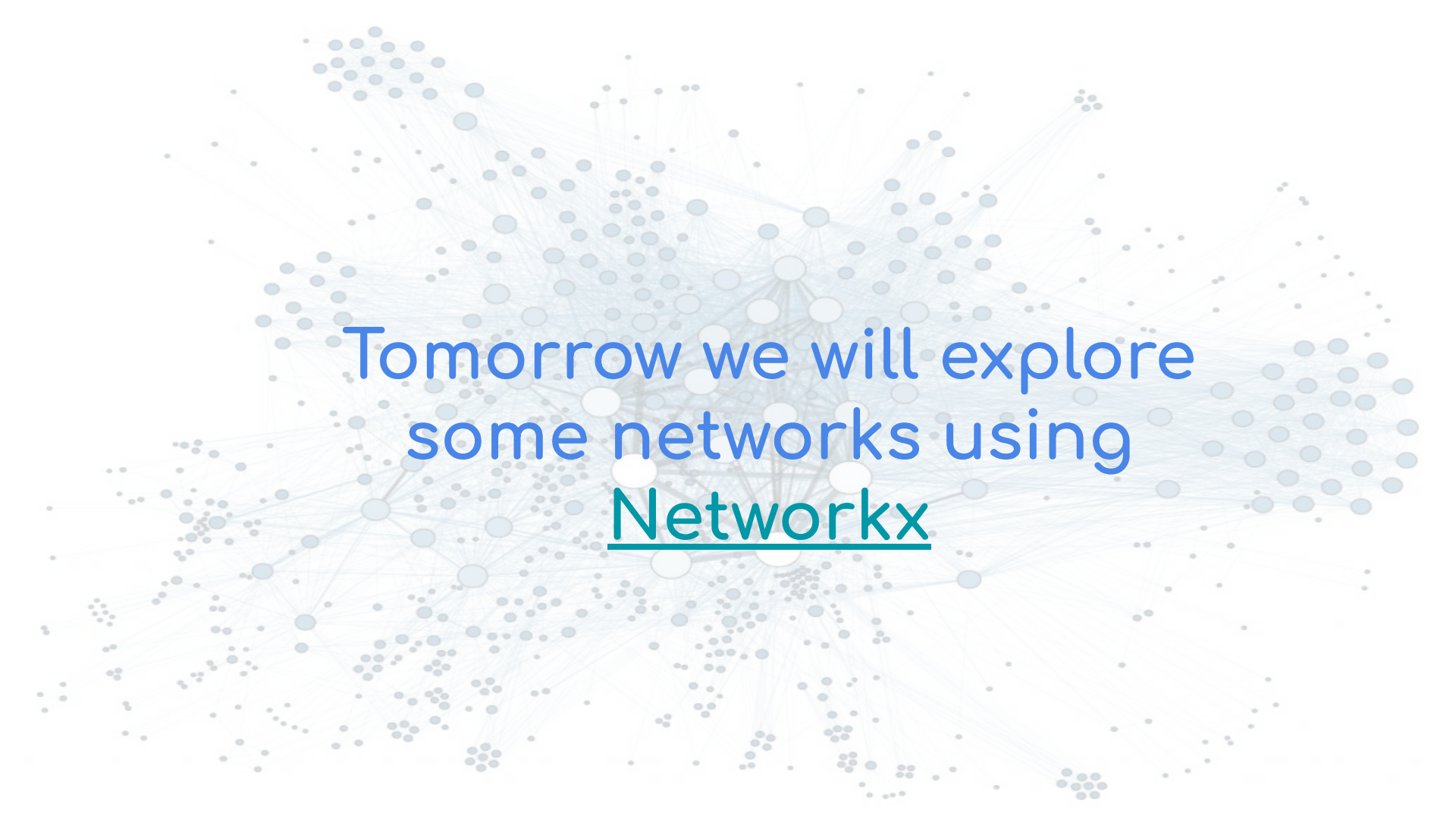
		0	1	2	3	4	5	6	7	8
		P	Q	R	S	T	W	X	Y	Z
0	P	0	0	1	0	0	1	0	0	0
1	Q	0	0	0	0	0	0	1	0	0
2	R	0	0	0	0	0	0	1	0	0
3	S	0	0	0	0	1	0	0	0	0
4	T	0	0	0	0	0	1	0	0	0
5	W	0	0	0	1	0	0	0	1	0
6	X	0	0	0	0	0	0	0	0	0
7	Y	0	0	1	0	0	0	0	0	1
8	Z	0	0	0	0	0	0	0	0	0

- Exercise: Write the adjacency matrix for the following networks:








Tomorrow we will explore some networks using Networkx