networks *motivation*

introduction to *network analysis* (*ina*)

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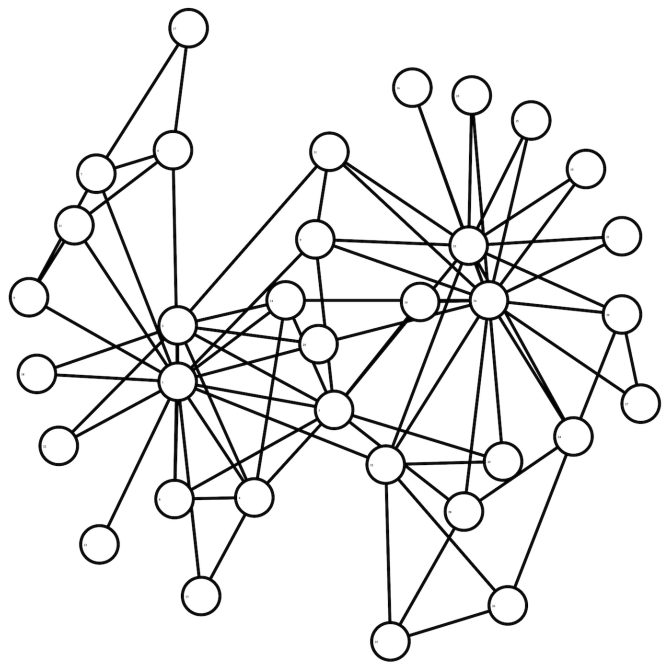
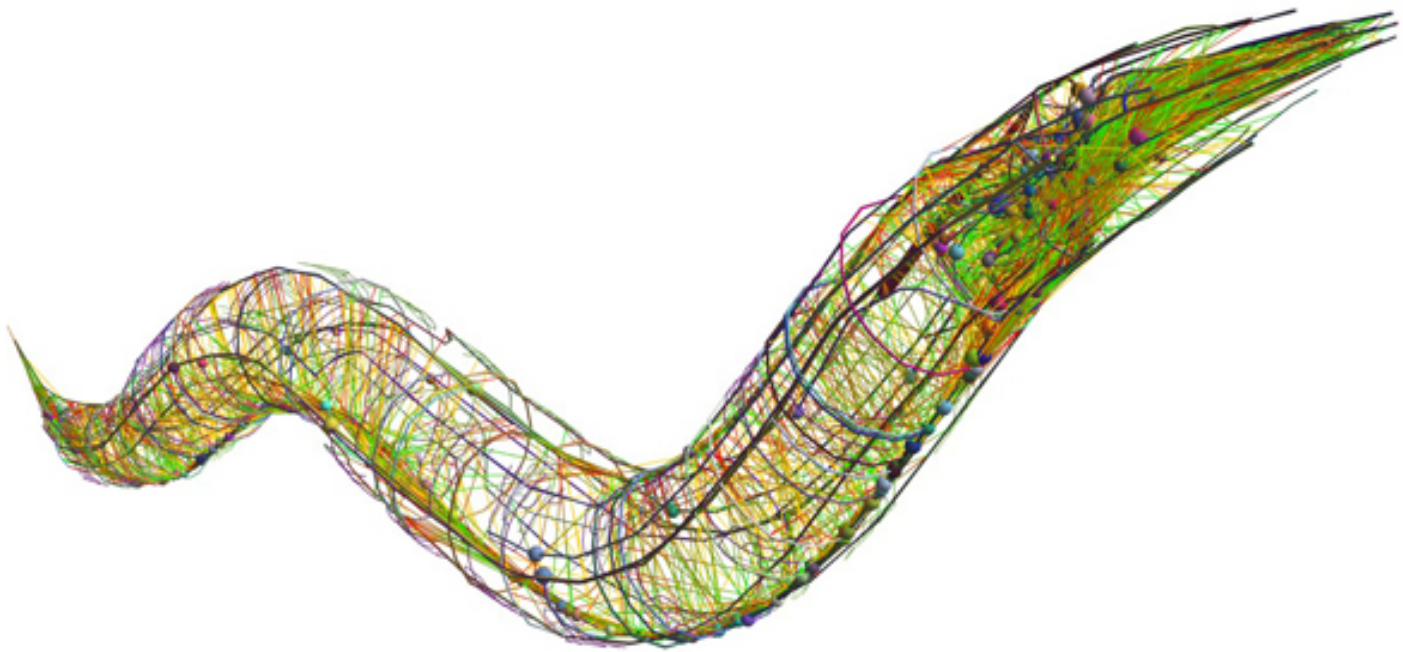
motivation *network*

- *network/graph* as wiring diagram
- points are called *nodes/vertices*
- points are connected by *links/edges*



motivation *neural wiring*

- *human brain* $\approx 10^{11}$ neurons
- nodes are *C. elegans neurons*
- links are *synapses*

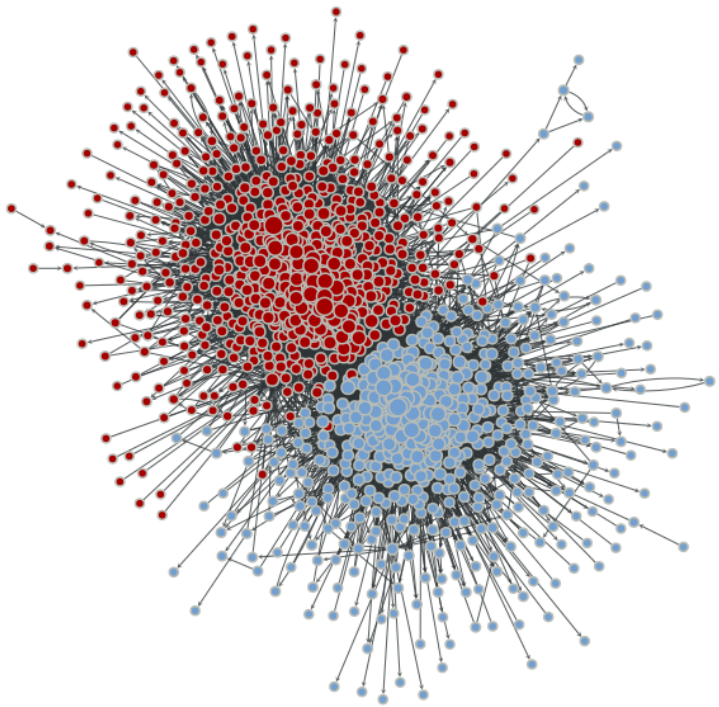


motivation *Web*

— *Web graph* $> 10^{12}$ pages

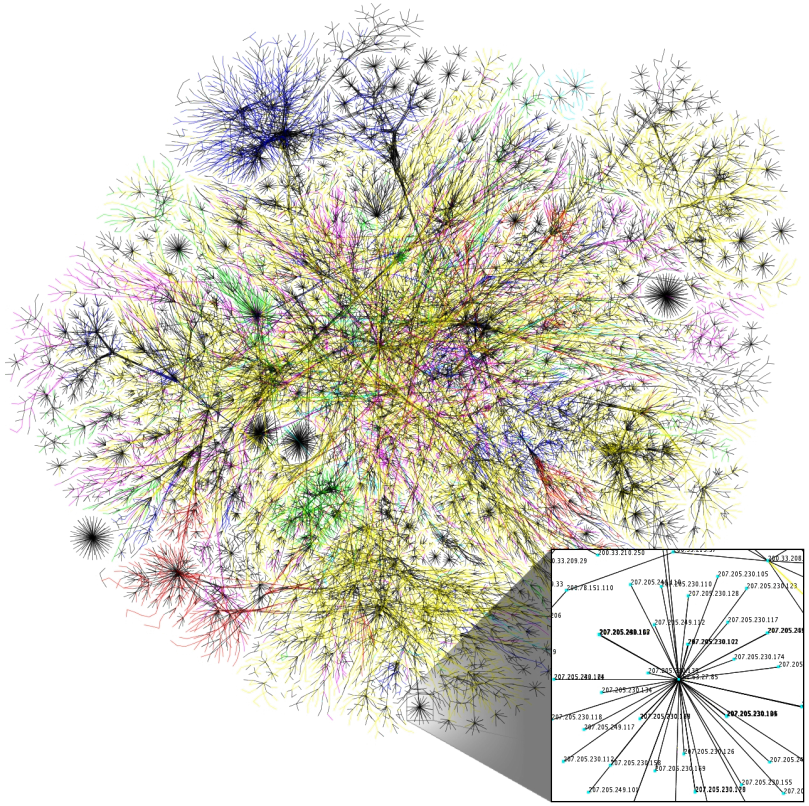
— nodes are *web pages*

— links are *hyperlinks*



motivation *Internet*

- Internet *overlay map*
- nodes are *class C subnets*
- links are *packet routes*

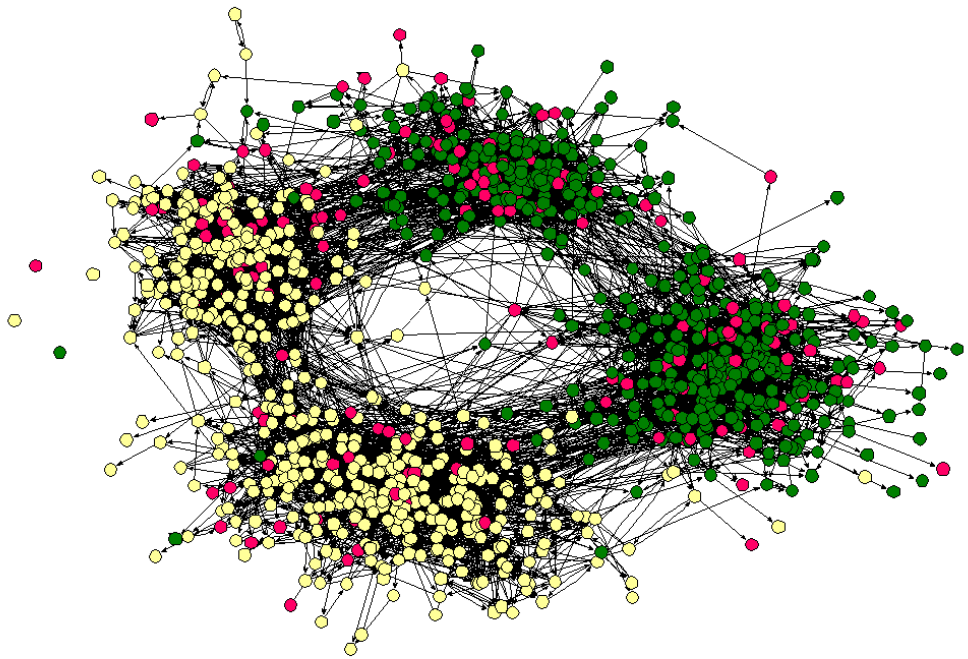


motivation *Facebook*

- *online social* network $> 10^9$ users
- nodes are *Facebook users*
- links are *social connections*

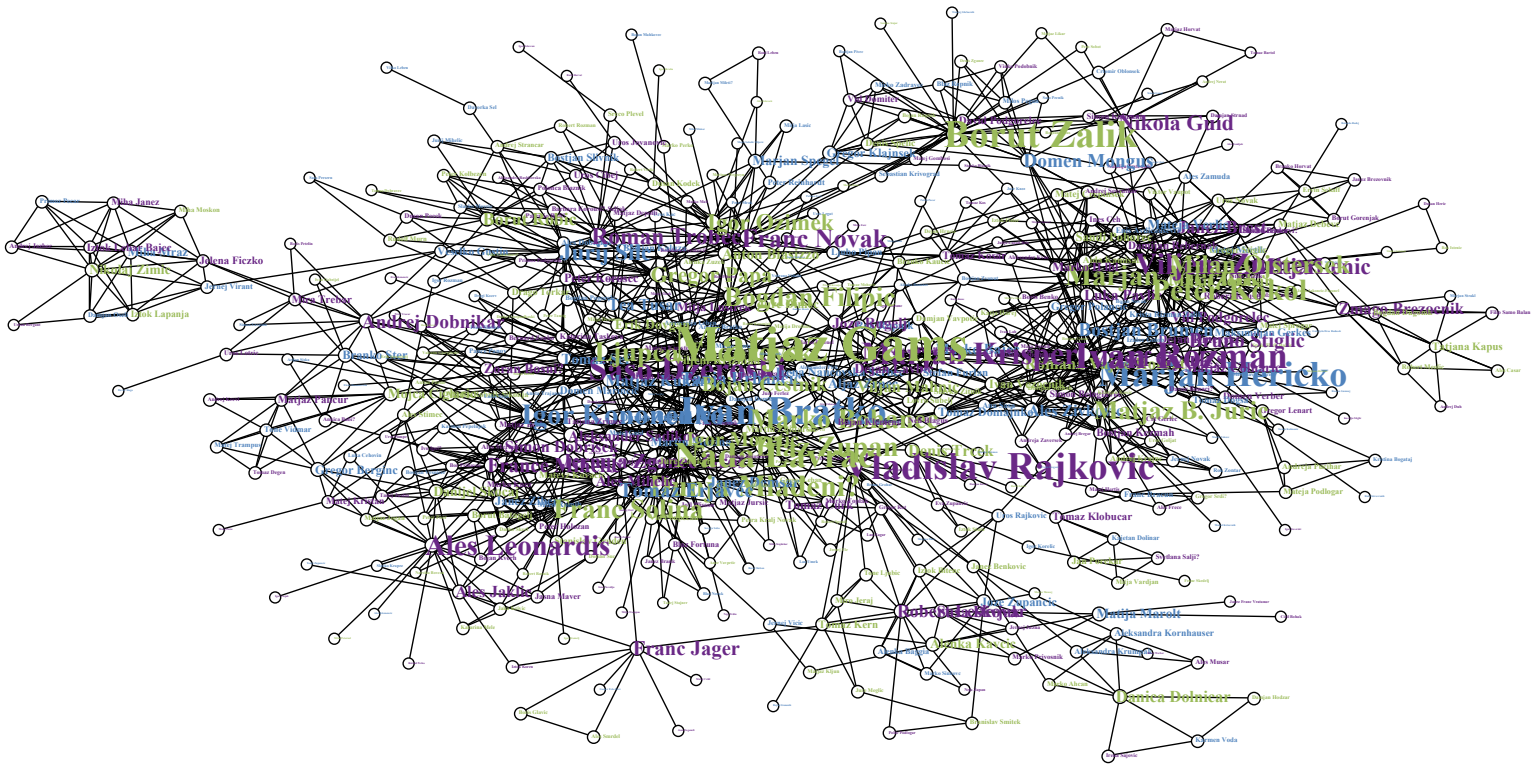
motivation *society*

- *offline social* network
- nodes are *high schoolers*
- links are *friendship ties*



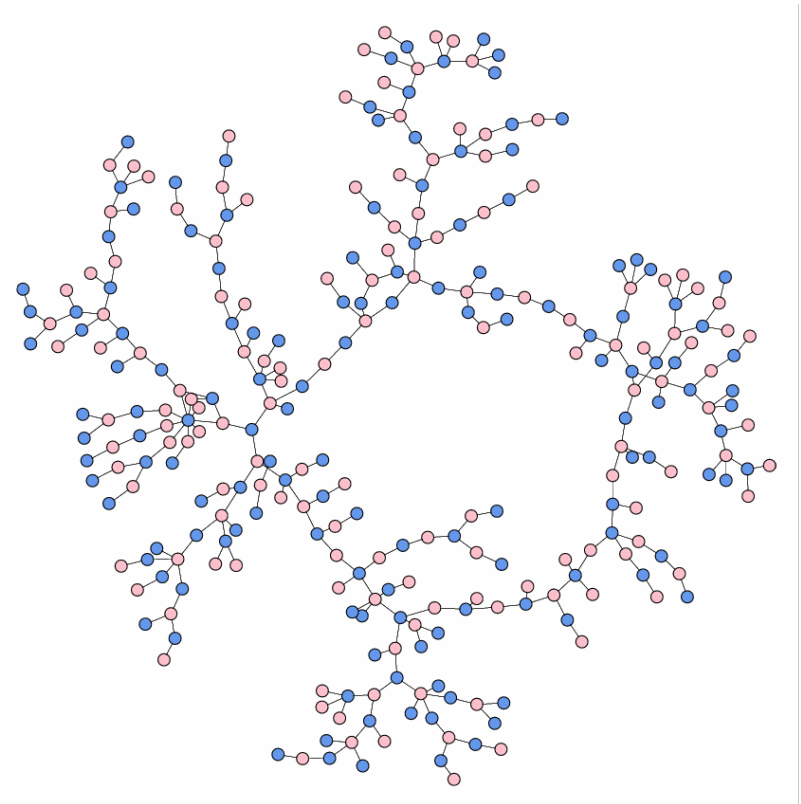
motivation *collaboration*

- *author collaboration* network
- nodes are *Slovenian computer scientists*
- links are *paper coauthorships* until 2010



motivation *sex*

- *sexual contact* network
- nodes are *men/women*
- links are *sexual contacts*

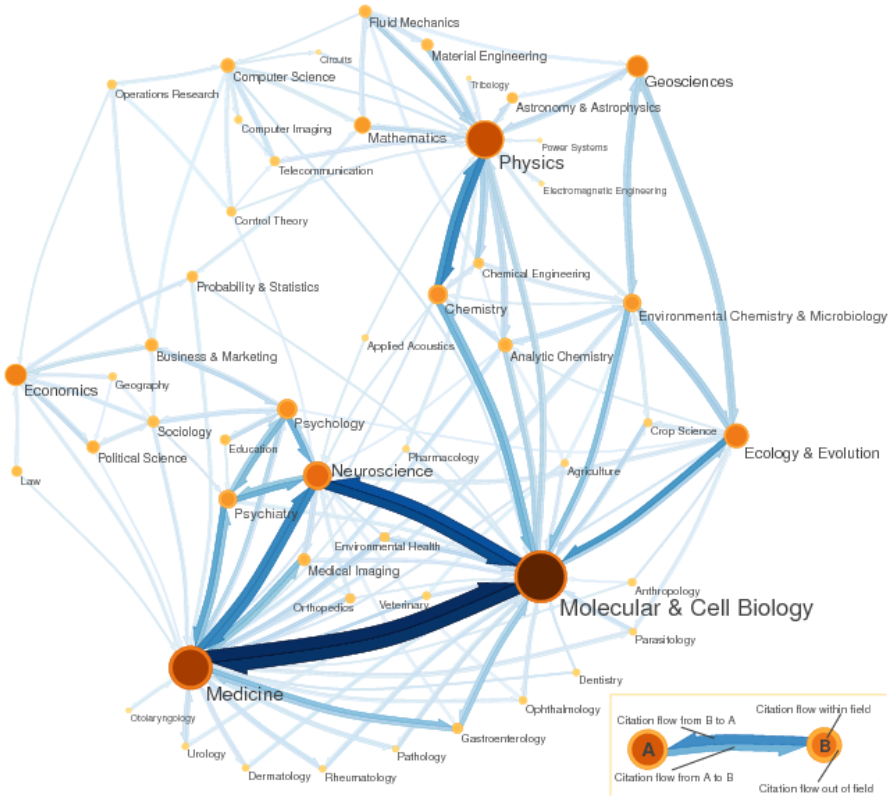


motivation *science*

— *map of science* network

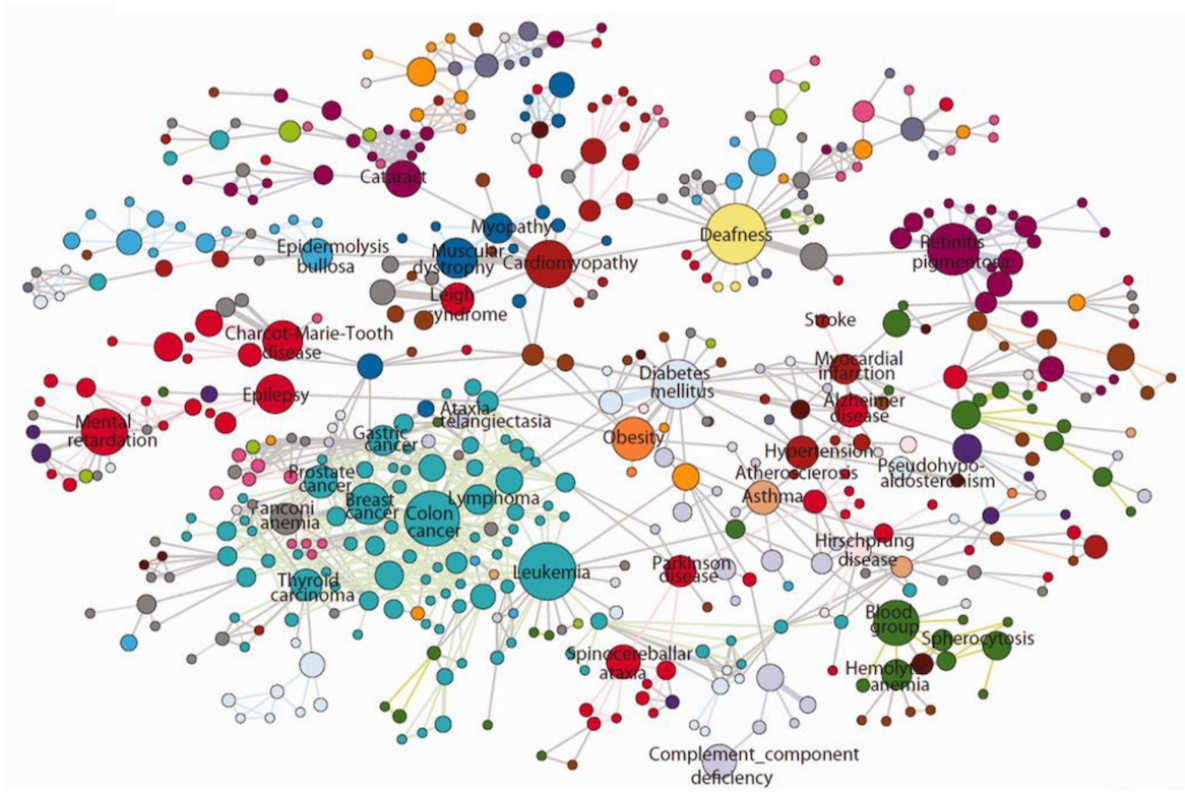
— nodes are *scientific fields*

— links are *journal citations*



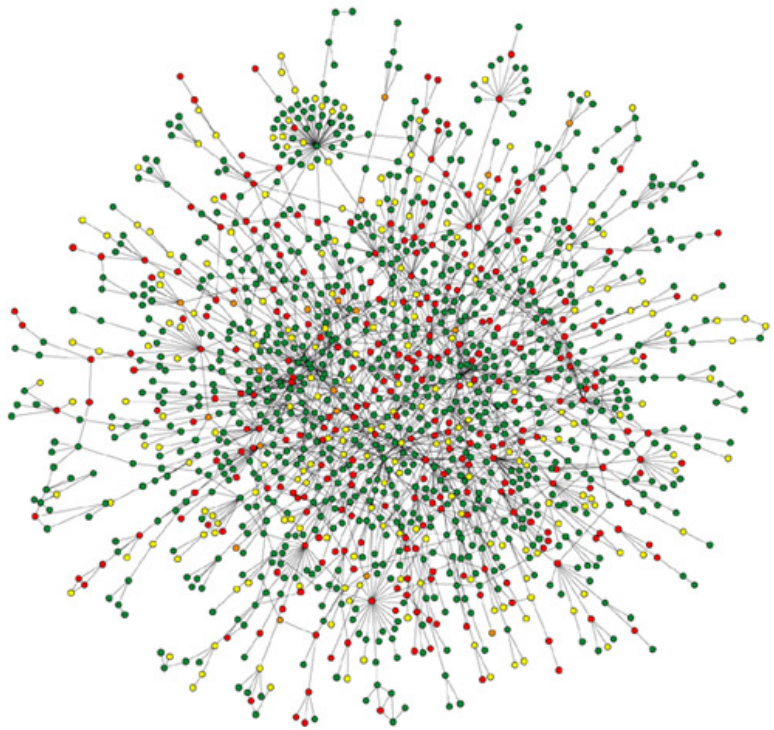
motivation *medicine*

- *human diseaseome* network
- nodes are *human diseases*
- links show *shared genes*



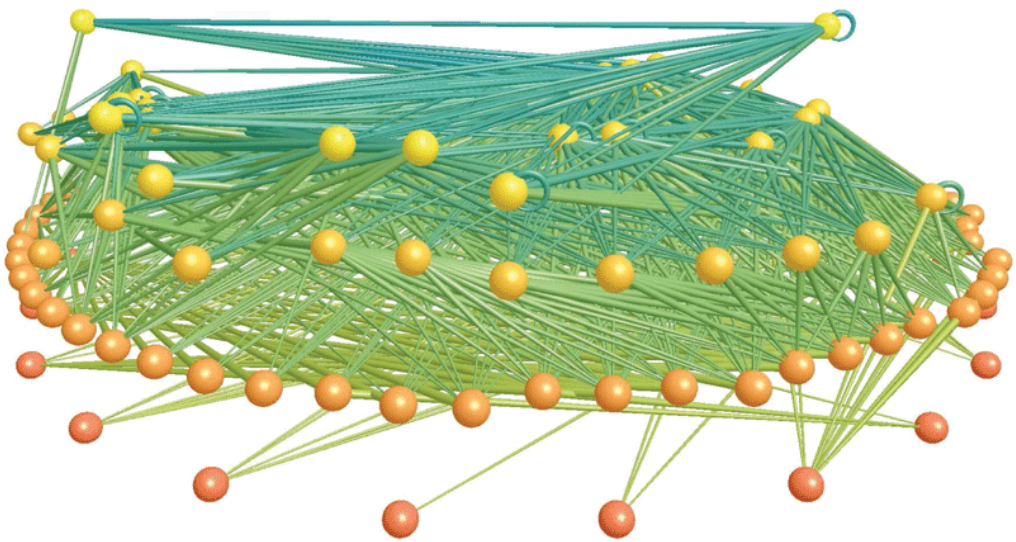
motivation *biology*

- *protein interaction* network
- nodes are *S. cerevisiae proteins*
- links are *physical interactions*



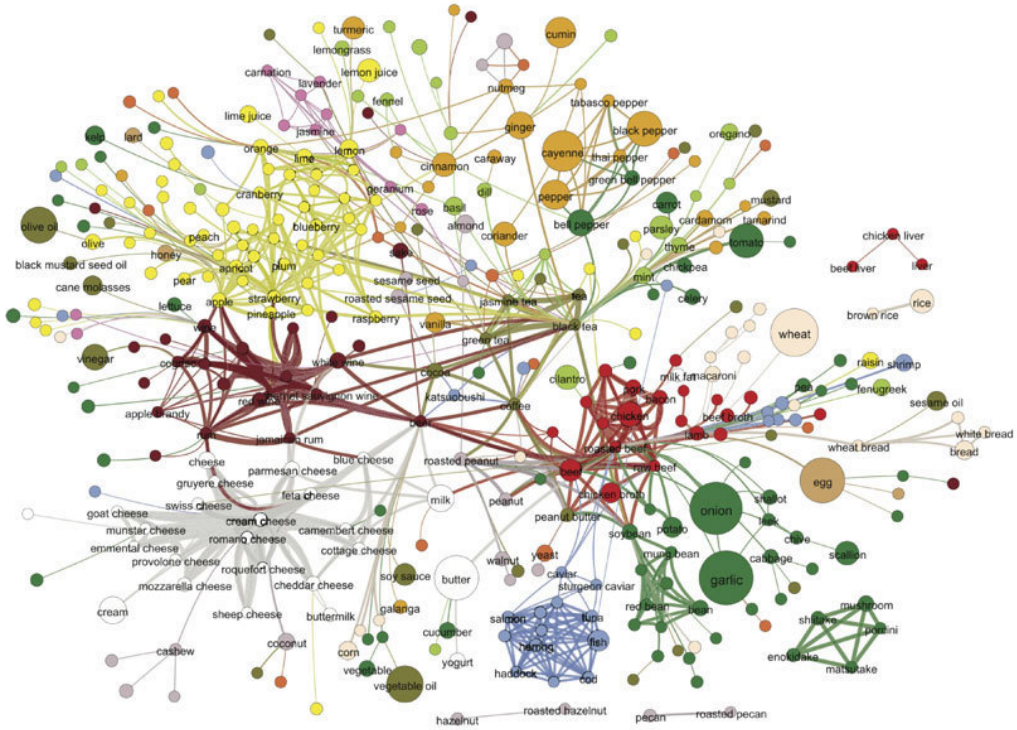
motivation *ecology*

- ecosystem *food web*
- nodes are *lake species*
- links are *predatory interactions*



motivation *gastronomy*

- *ingredient/flavor* network
- nodes are *recipe ingredients*
- links show *shared flavors*

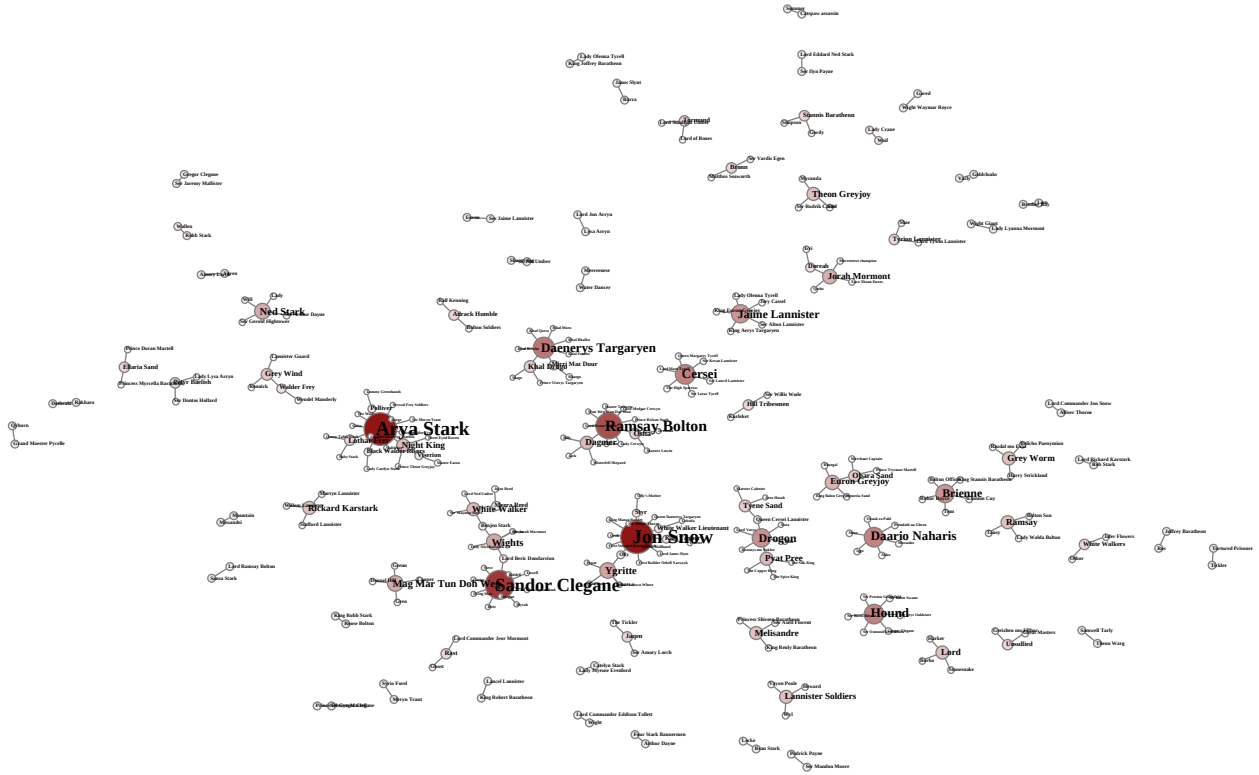


motivation *entertainment*

— *Game of Thrones* network

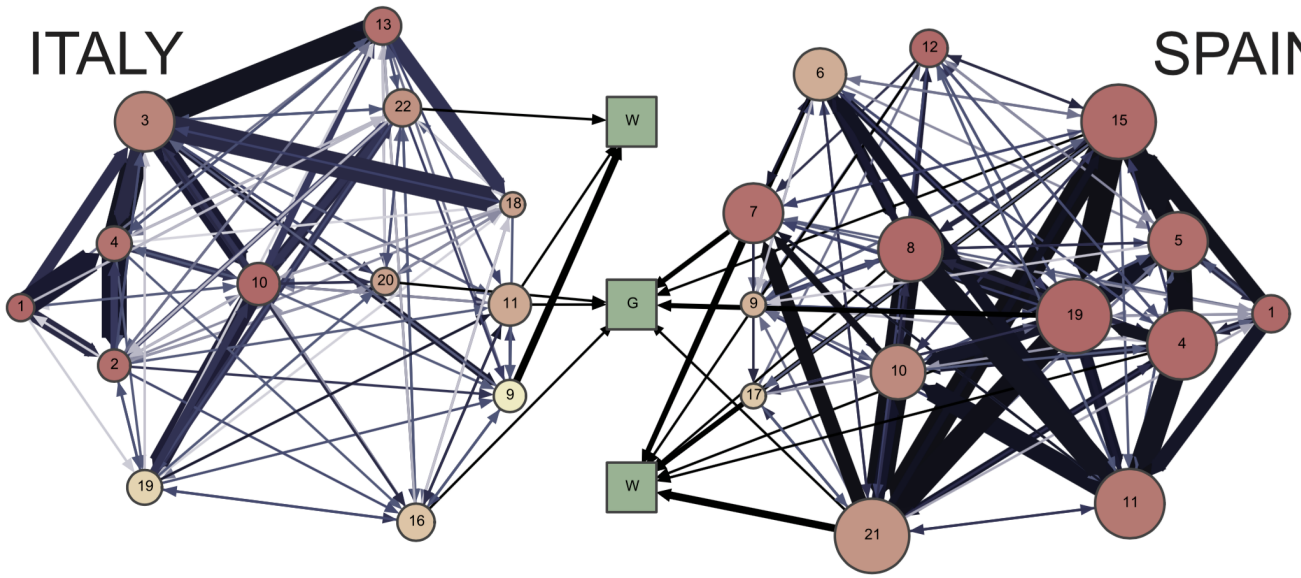
— nodes are *GoT characters*

— links show *who killed whom*



motivation *sports*

- *football player* network
- nodes are *player positions*
- links are *successful passes*

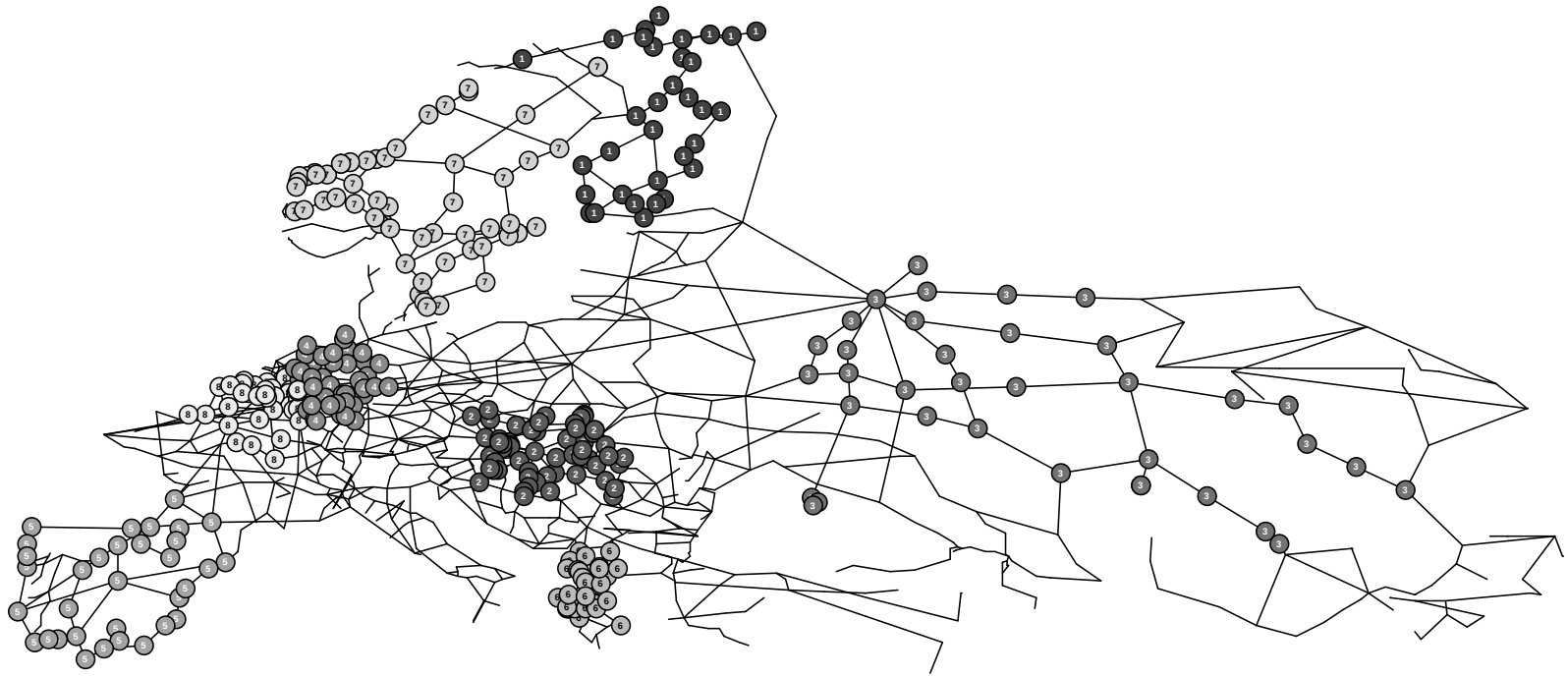


motivation *transport*

- *air transportation* network
- nodes are *world airports*
- links show *passenger flux*

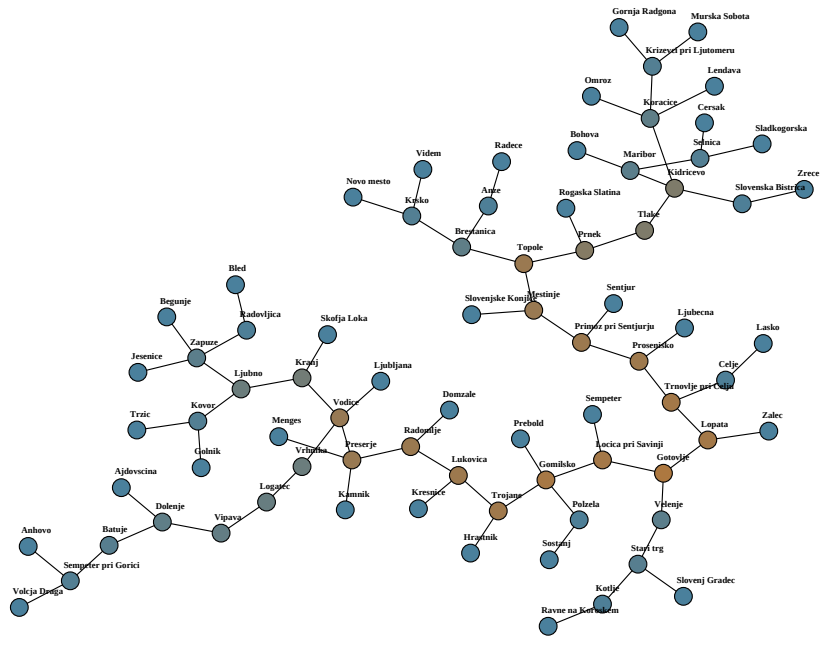
motivation *Europe*

- *road infrastructure* network
- nodes are *European cities*
- links are *highways*



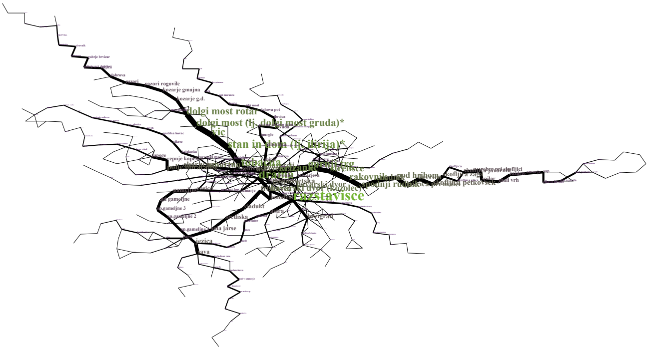
motivation *Slovenia*

- *technological/infrastructure* networks
- nodes are *geographical locations*
- links are *pipes/highways*



motivation *Ljubljana*

- LPP *bus map*
- nodes are *bus stops*
- links are *bus routes*

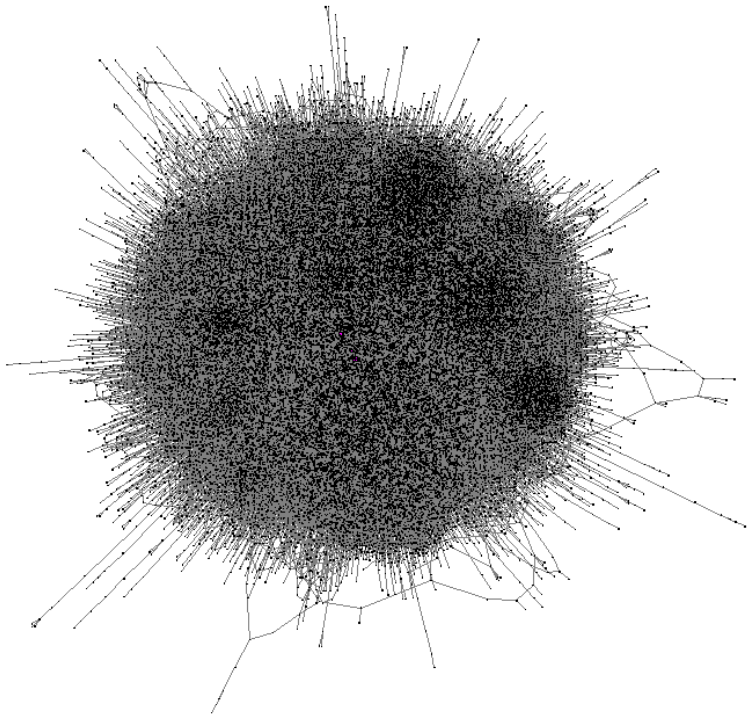


motivation *hairballs*

— but most networks are too *large/dense/complex*

— thus visualizations look like *ridiculograms*

visually stunning but scientifically worthless

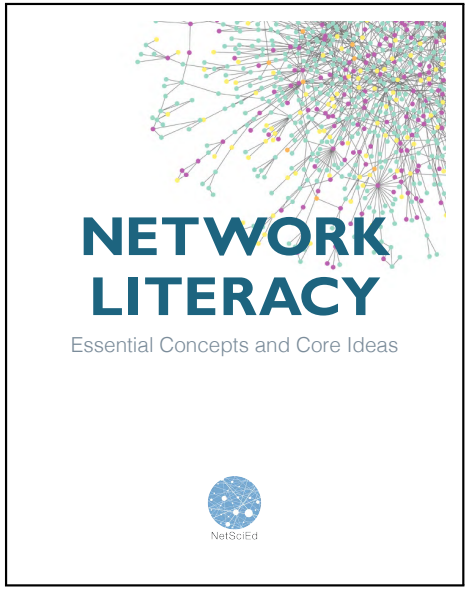


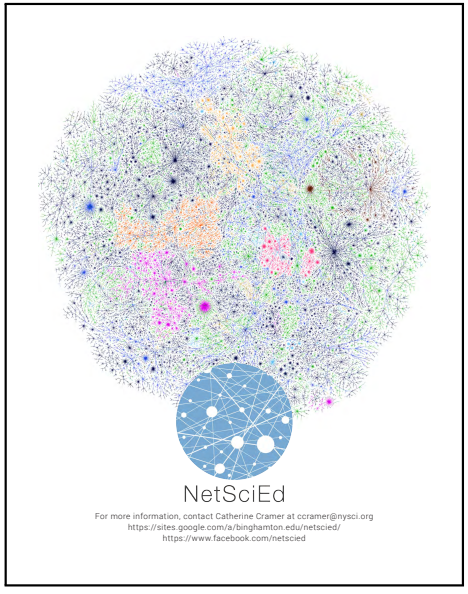
motivation *networks*

— must *study networks* to *understand real systems*

— how to "see" networks too complex to visualize?

— through their *structure*, *evolution* and *dynamics*





motivation *documentary*

connected

the power of six degrees

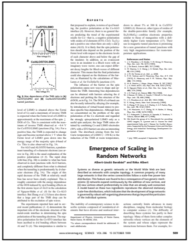
documentary on small-world and scale-free networks


letters to nature

Collective dynamics of 'small-world' networks

Duncan J. Watts & Steven H. Strogatz

[WS98]


Emergence of Scaling in Random Networks

Albert-László Barabási and Réka Albert

[BA99]


letters to nature

Error and attack tolerance of complex networks

[AJB00]

motivation *references*

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