

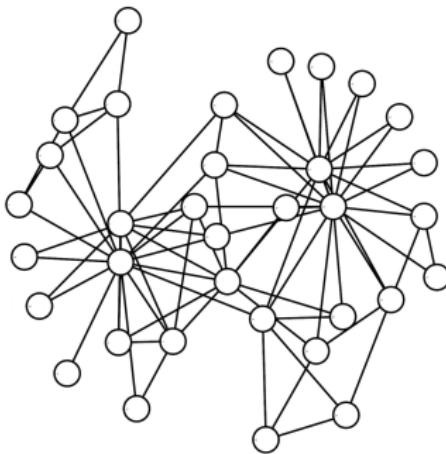
# networks *motivation*

introduction to *network science in Python* (*NetPy*)

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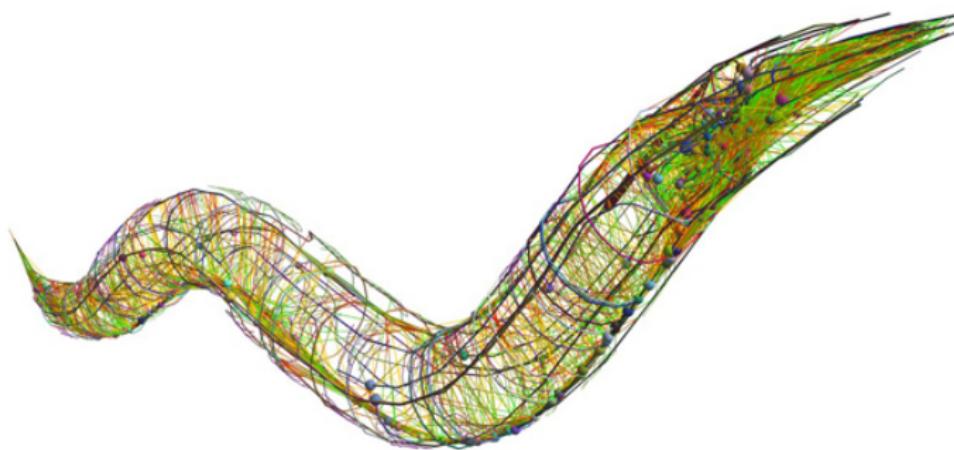
# motivation *network*

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



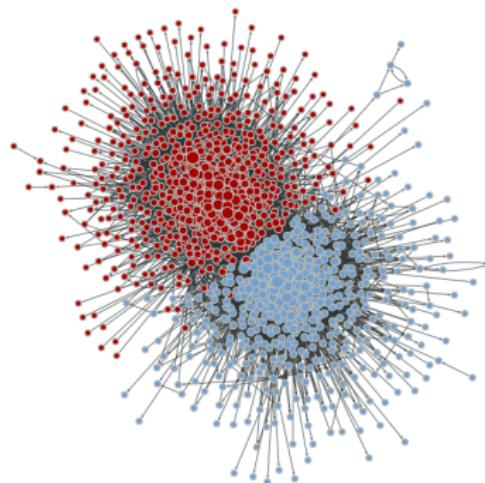
## motivation *neural wiring*

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



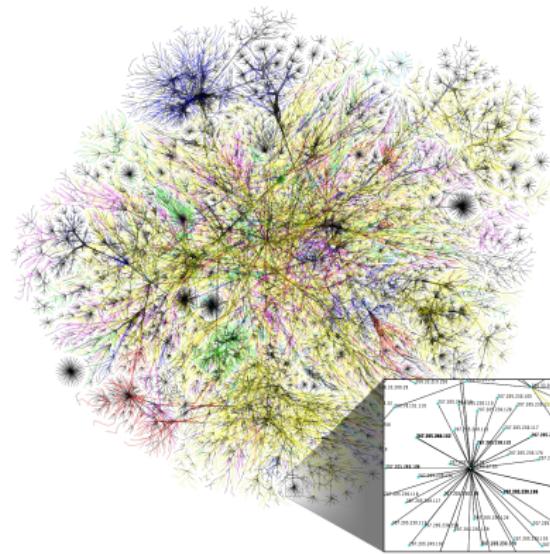
## motivation *Web*

- *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*



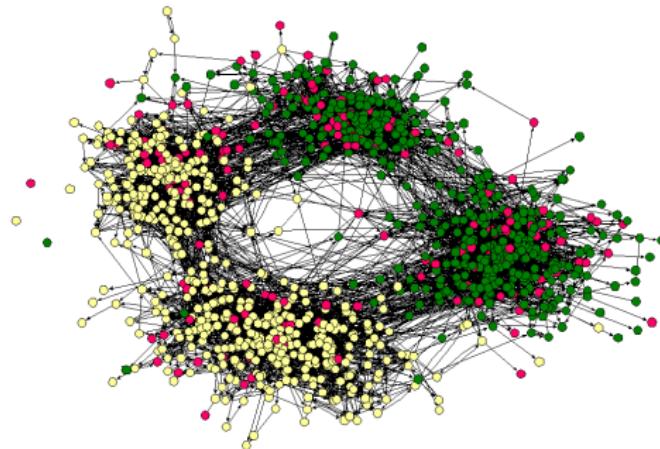
## motivation *Facebook*

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



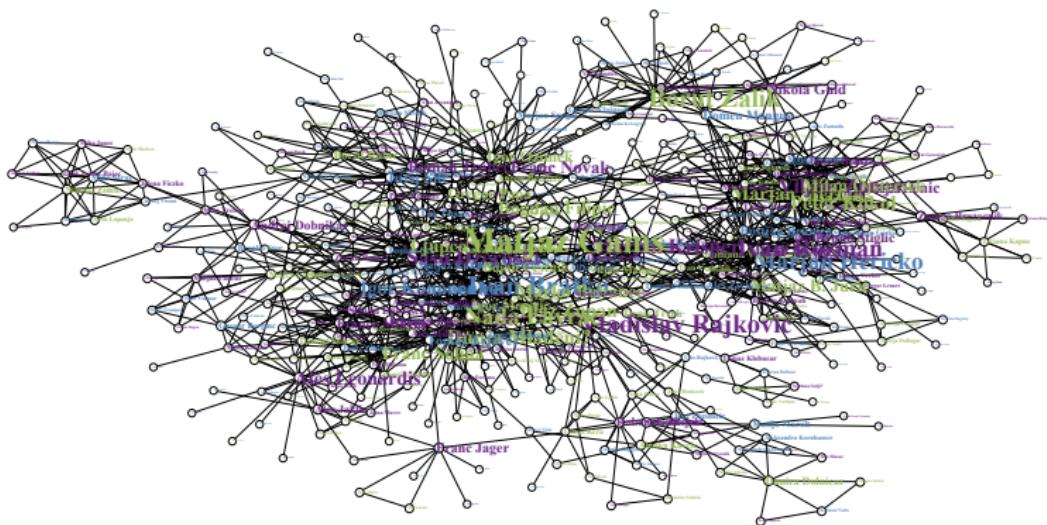
# motivation *society*

- *offline social* network
- nodes are *school children*
- links are *friendship ties*



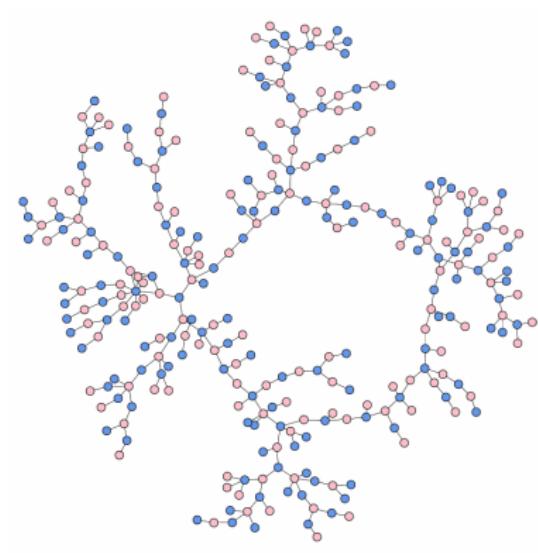
# motivation *collaboration*

- *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*



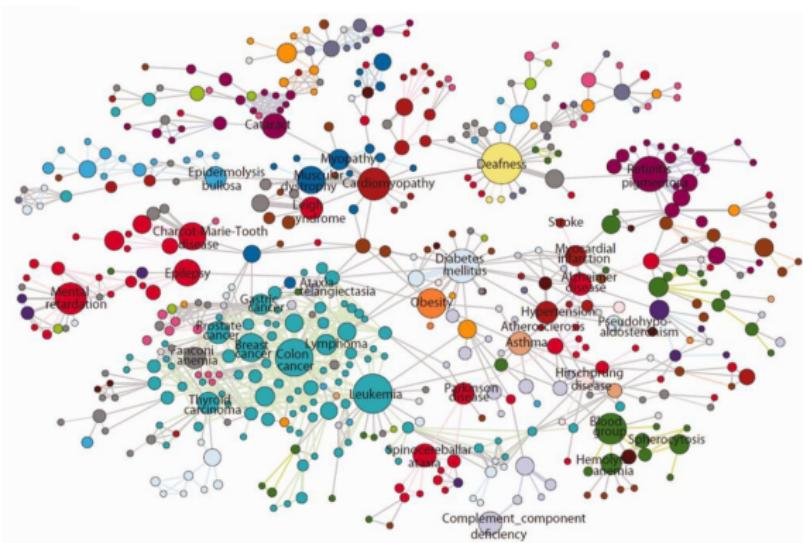
## motivation *transport*

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



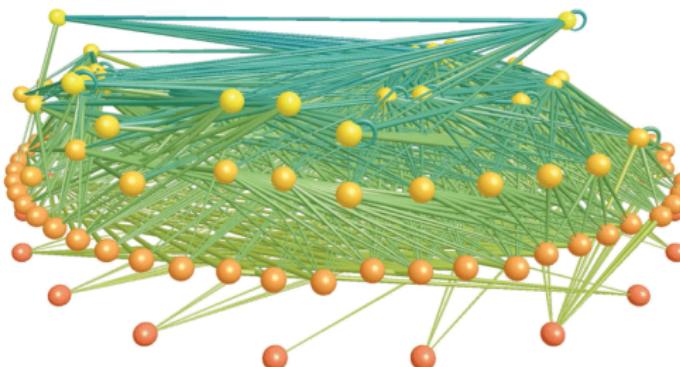
# motivation *medicine*

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



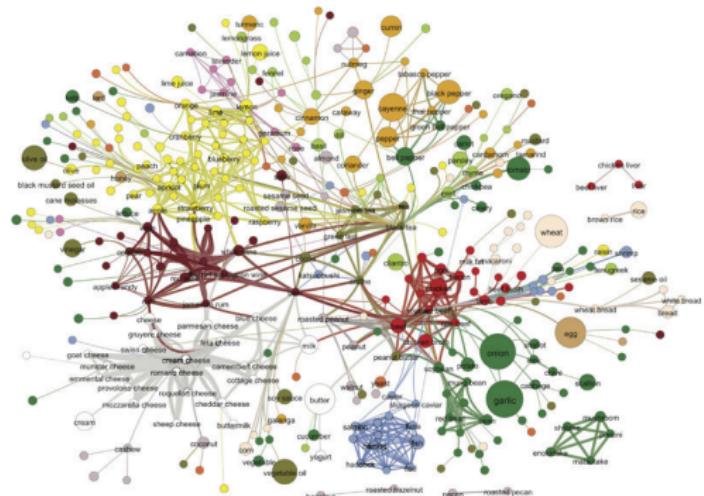
# motivation *ecology*

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



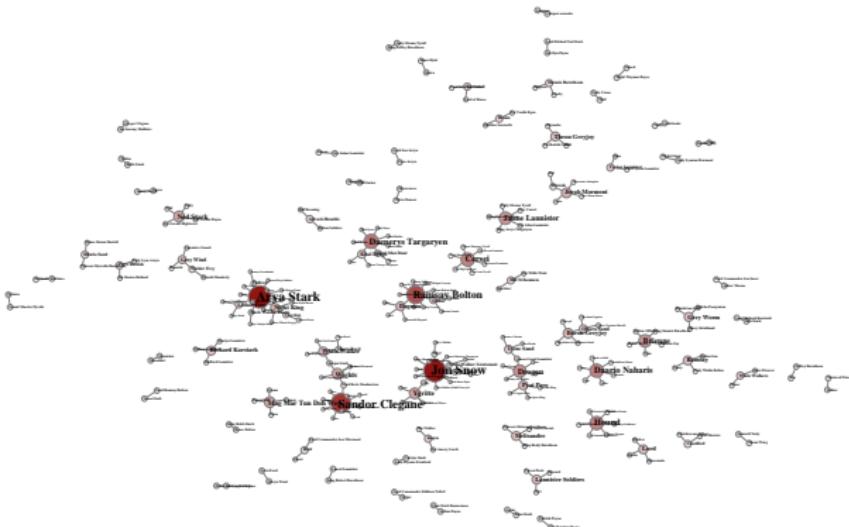
# motivation *gastronomy*

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



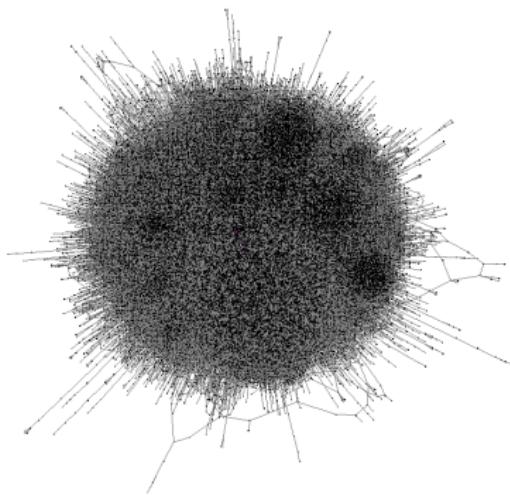
# motivation *entertainment*

- *Game of Thrones* network
- nodes are *GoT characters*
- links show *who killed whom*



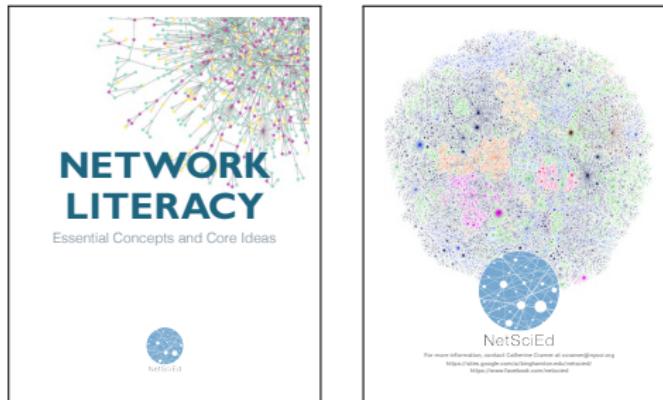
## motivation *hairballs*

- 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



[WS98]



[BA99]



[AJB00]

# introduction *references*

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