

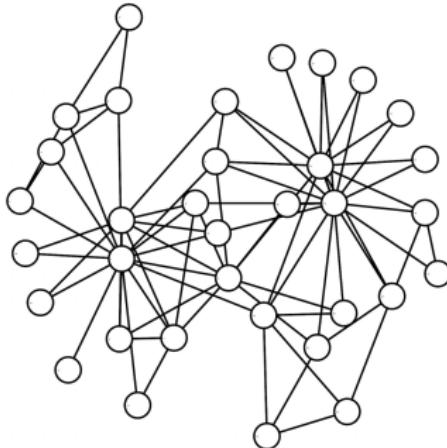
# networks *introduction*

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

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19th Sep 2019

# introduction *network*

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



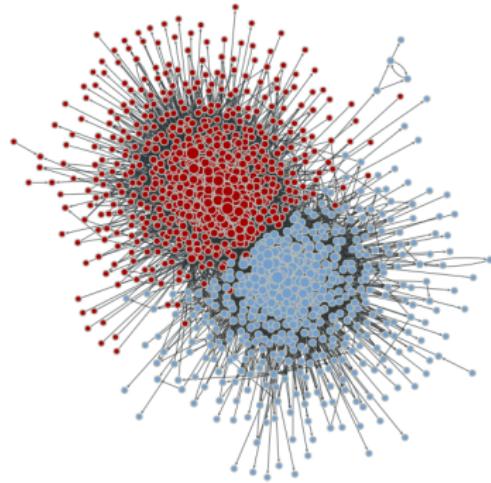
## introduction *neural wiring*

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



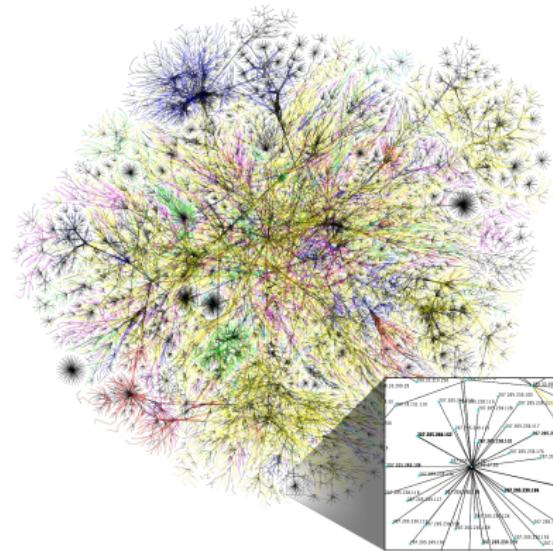
# introduction *Web*

- *Web graph*  $> 10^{12}$  pages
- nodes are *web pages*
- links are *hyperlinks*



# introduction *Internet*

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



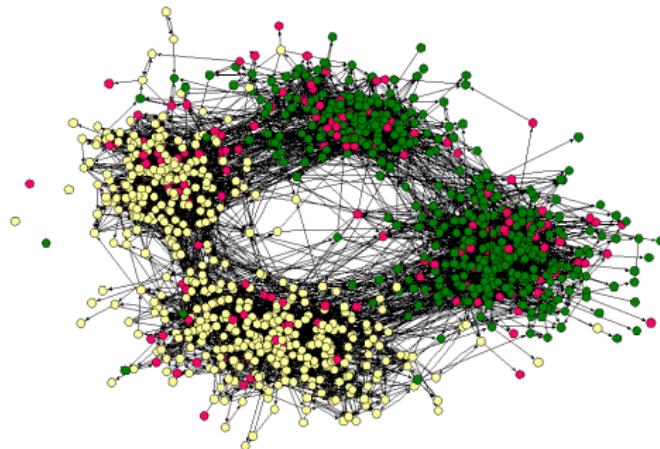
# introduction *Facebook*

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



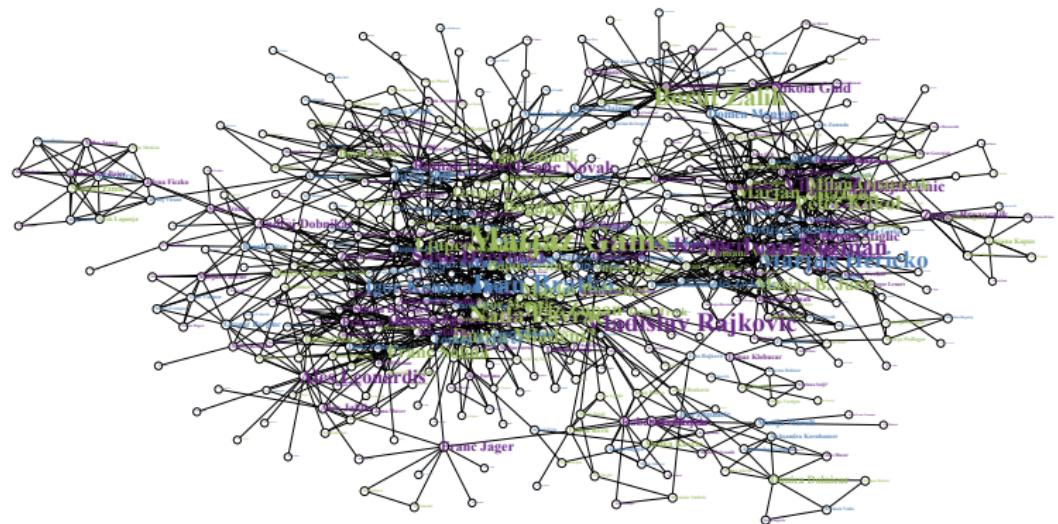
# introduction *society*

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



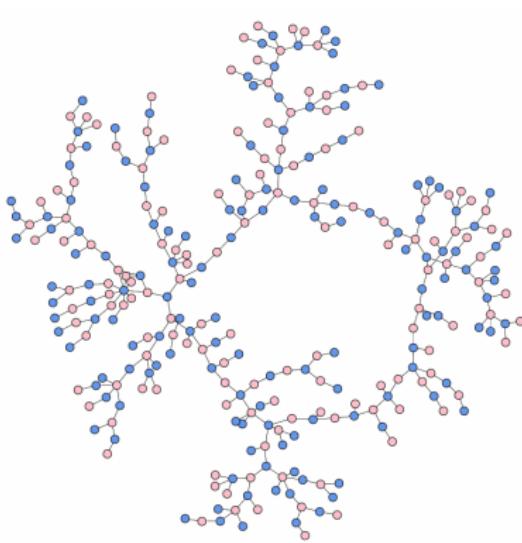
# introduction *collaboration*

- *author collaboration* network
- nodes are *Slovenian computer scientists*
- links are *paper coauthorships*  $\leq 2000$



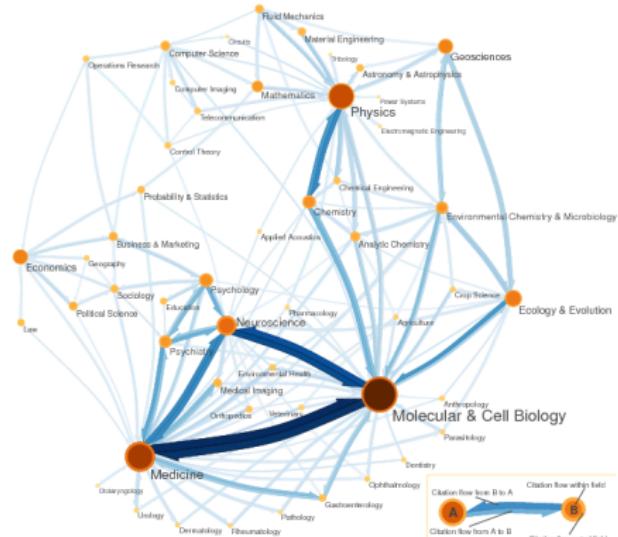
# introduction *sex*

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



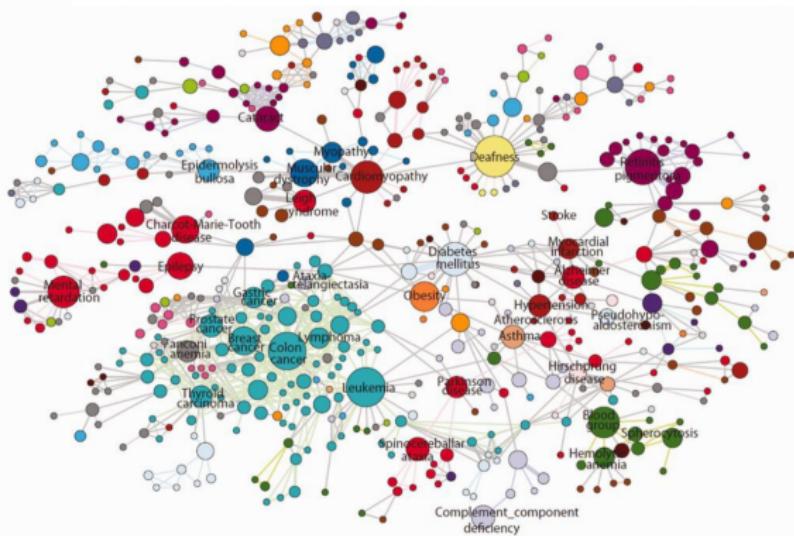
# introduction *science*

- *map of science network*
- nodes are *scientific fields*
- links are *journal citations*



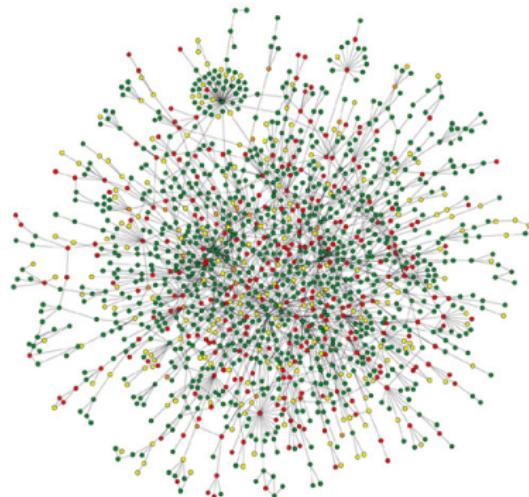
# introduction *medicine*

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



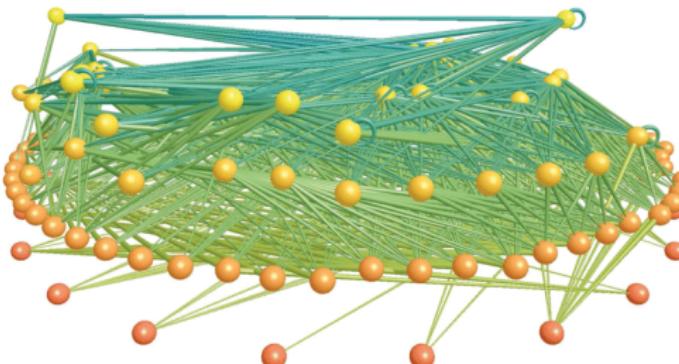
# introduction *biology*

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



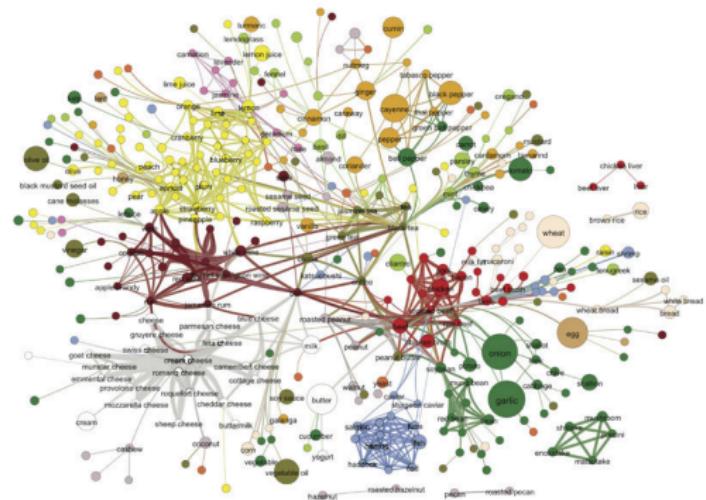
# introduction *ecology*

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



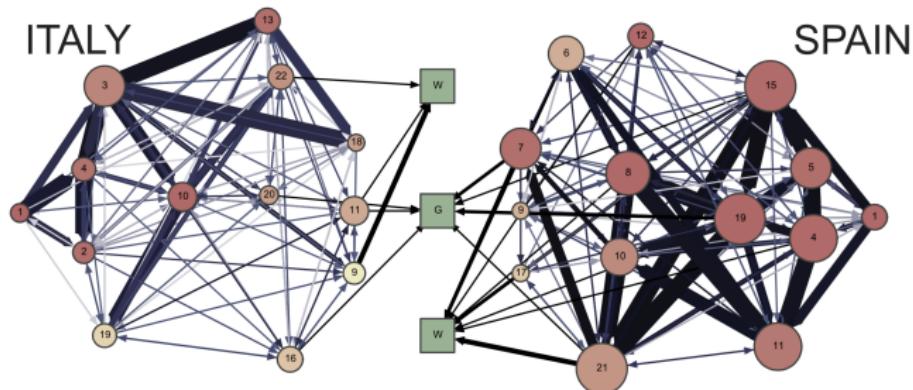
# introduction *gastronomy*

- *ingredient/flavor* network
- nodes are *recipe ingredients*
- links are *flavor compounds*



# introduction *sports*

- *football player* network
- nodes are *football players*
- links are *player passes*



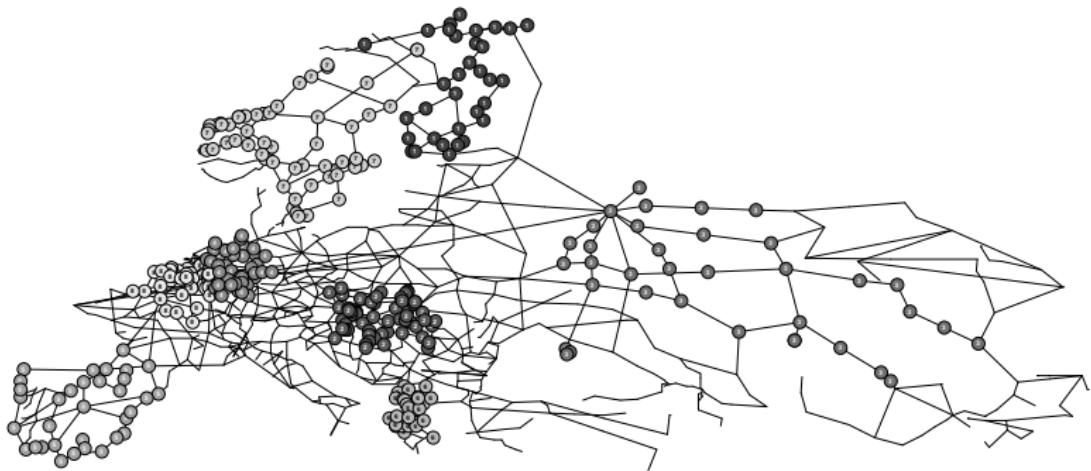
# introduction *transport*

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



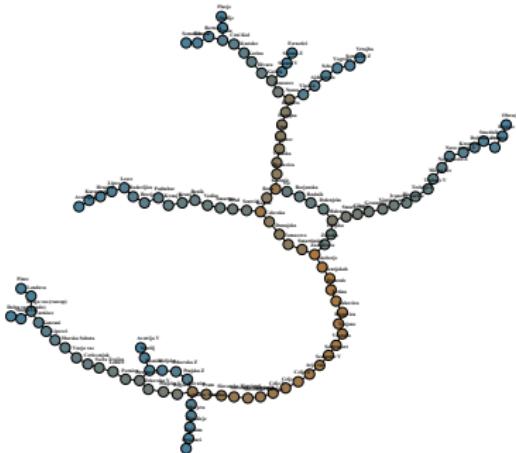
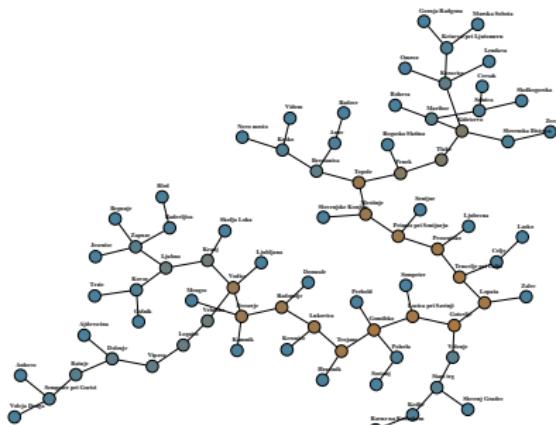
# introduction *Europe*

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



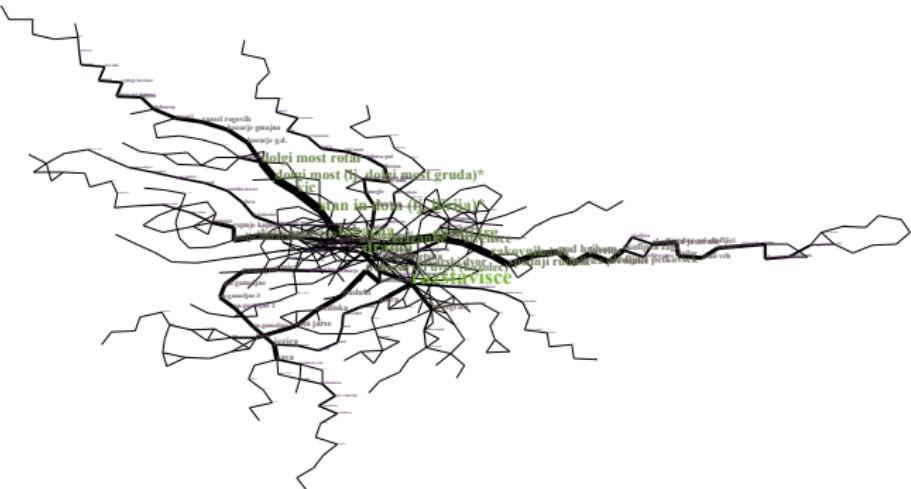
# introduction *Slovenia*

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



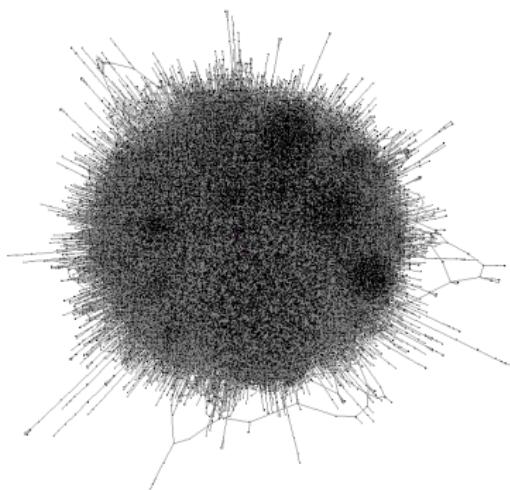
# introduction *Ljubljana*

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



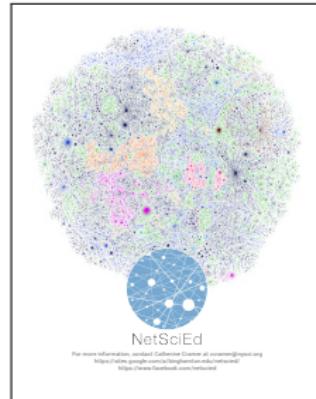
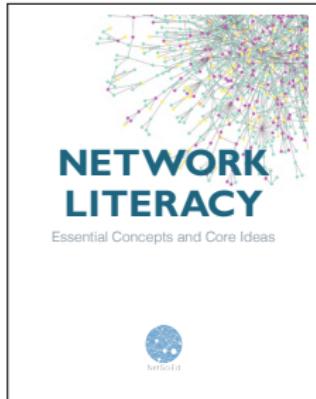
# introduction *hairballs*

- most networks are *large/dense/complex*
- visualizations look like *ridiculograms*  
visually stunning but scientifically worthless



# introduction *networks*

- must *study networks* to *understand real systems*
- how to see what is too complex to visualize?
- through *structure, evolution* and *dynamics*



# introduction *documentary*

## *connected* the power of six degrees

documentary on small-world and scale-free networks



[WS98]



[BA99]



[AJB00]

# introduction *references*

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