Complex Networks
Orientation

2018.11.28(Thu)

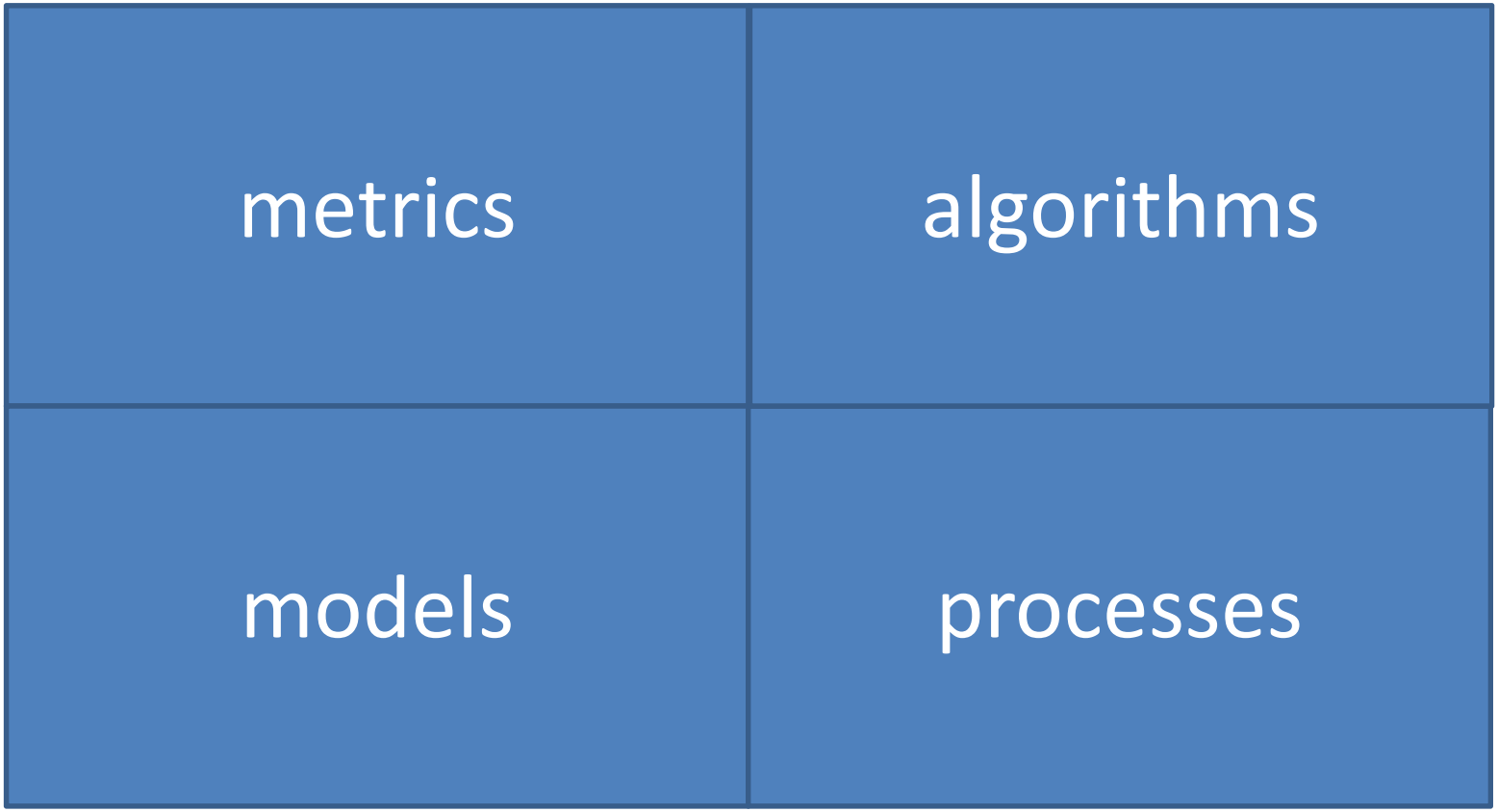
Complex Networks

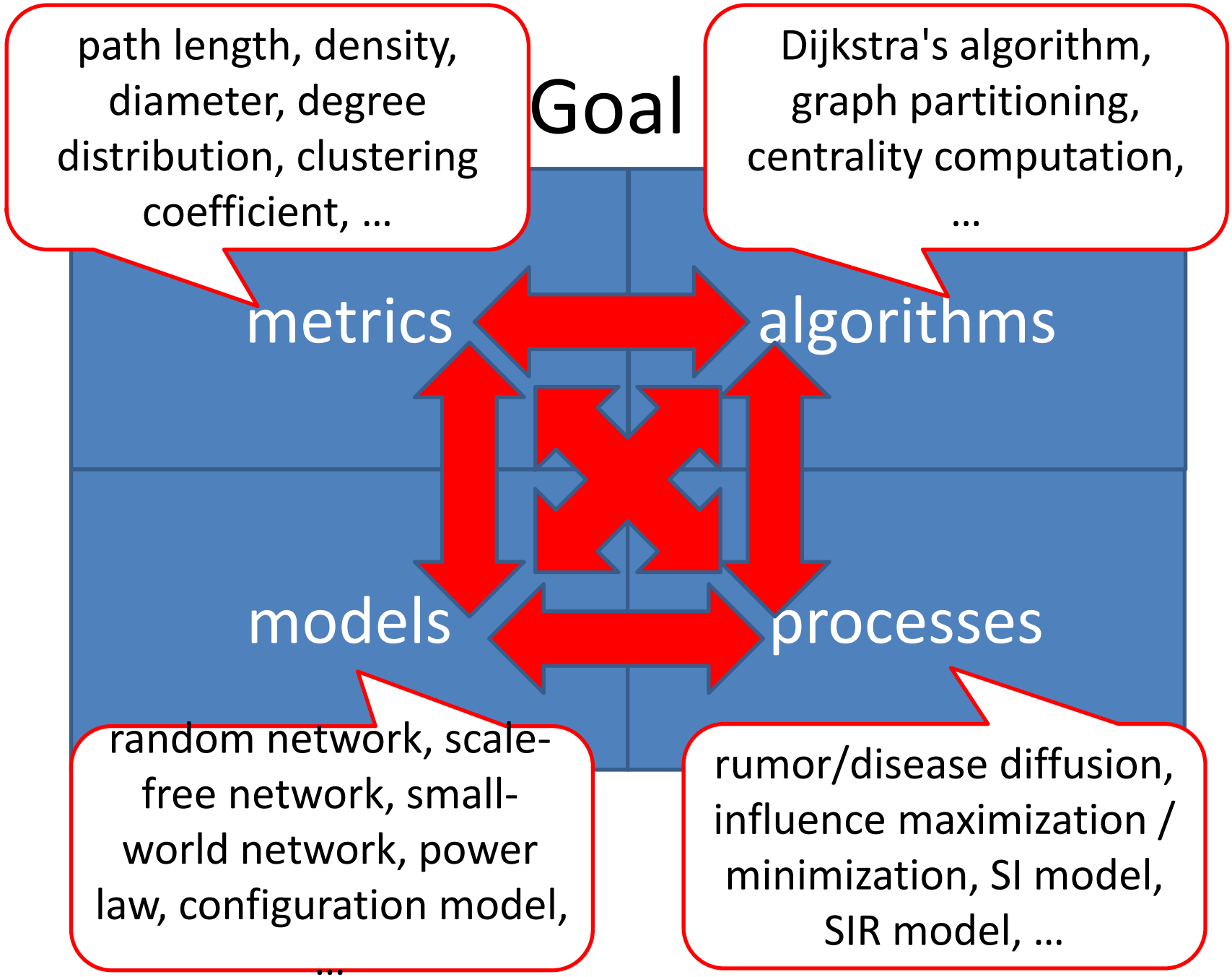
- Instructor: Tsuyoshi Murata (murata@c.titech.ac.jp)
- Goal: acquire knowledge for understanding and analyzing networks (graphs)
- Score : based on quizzes and assignments
- Classes: Monday & Thursday (10:45-12:15)
- Teaching materials : available at Tokyo Tech OCW (and www.net.c.titech.ac.jp/lecture/cn)

Schedule

- Nov.29(Thu) today
- Dec.3(Mon)
- Dec.6(Thu)
- Dec.10(Mon)
- Dec.13(Thu) canceled
- Dec.17(Mon)
- Dec.20(Thu)
- Dec.24(Mon) class on Christmas Eve ! (blame Tokyo Tech)
- Jan.7(Mon)
- Jan.10(Thu)
- Jan.17(Thu)
- Jan.21(Mon)
- Jan.24(Thu)
- Jan.28(Mon)
- Jan.31(Thu)
- Feb.4(Mon)

Goal

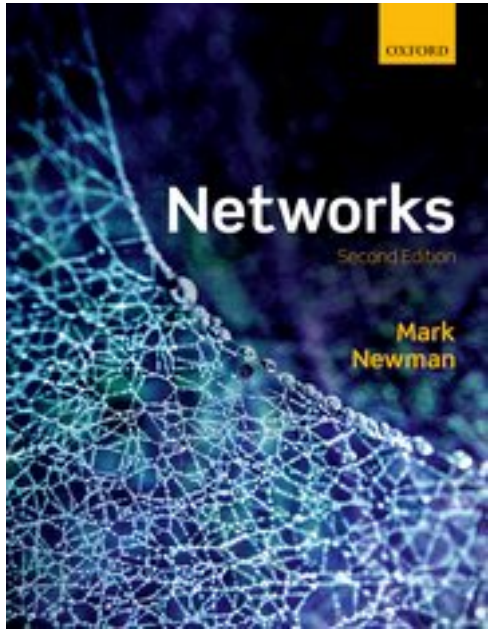



Goal
path length, density, diameter, degree distribution, clustering coefficient, …
Dijkstra's algorithm, graph partitioning, centrality computation, …
metrics
algorithms
models
processes
random network, scale-free network, small-world network, power law, configuration model, …
rumor/disease diffusion, influence maximization / minimization, SI model, SIR model, …

textbook

- Networks (second edition), Mark Newman, Oxford University Press, 2018.

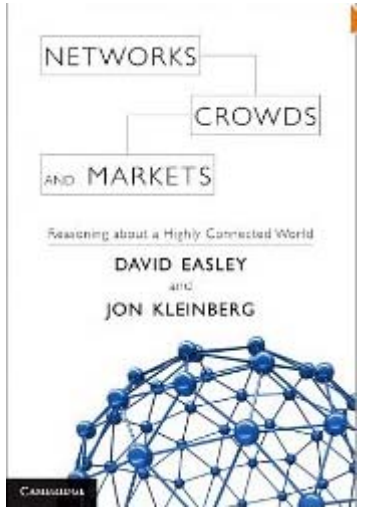
  https://global.oup.com/academic/product/networks-9780198805090



references

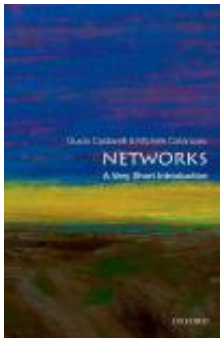
- Networks, Crowds, and Markets: Reasoning About a Highly Connected World, David Easley and Jon Kleinberg, Cambridge University Press, 2010.

  http://www.cs.cornell.edu/home/kleinber/networks-book/



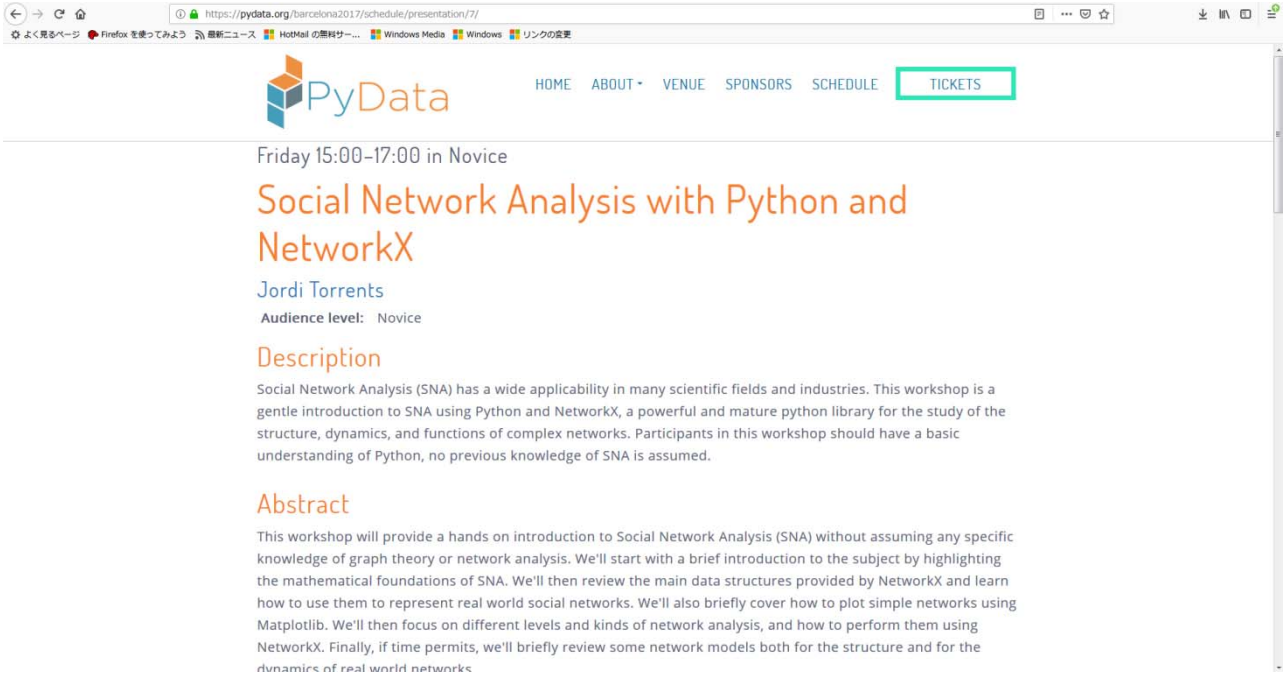
- Networks: A Very Short Introduction, Oxford University Press, 2012.

  https://www.oupjapan.co.jp/en/node/13481



online resources

- Social Network Analysis with Python and NetworkX
  - https://pydata.org/barcelona2017/schedule/presentation/7/
  - https://github.com/jtorrents/pydata_bcn_NetworkX



contents of this course

- Basic knowledge for understanding/analyzing networks
  - fundamentals of network
  - network algorithms
  - network models
  - processes on networks

  - tools for analyzing and visualizing networks

topics (1)

- 1. introduction
- 2. tools for analyzing networks
- 3. fundamentals (1) mathematics of networks
- 4. fundamentals (2) measures and metrics
- 5. fundamentals (3) the large-scale structure of networks
- 6. network algorithms (1) representation

topics (2)

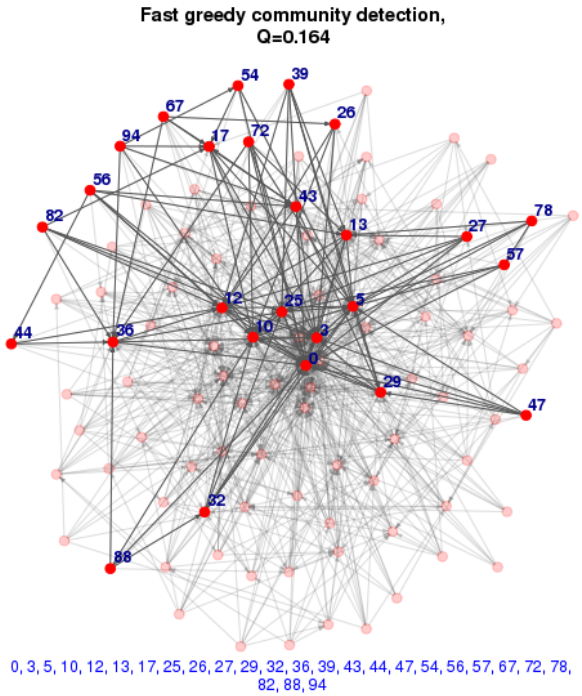
- 7. network algorithms (2) matrix algorithms
- 8. network algorithms (3) graph partitioning
- 9. network models (1) random graphs
- 10. network models (2) network formation
- 11. network models (3) small-world model
- 12. processes on networks (1) percolation
- 13. processes on networks (2) epidemics
- 14. summary

Remarks

- All lectures, quizzes, assignments will be in English this quarter. I will not accept quizzes & assignments written in Japanese.
- Non-CS students (undergraduate students, YSEP, ACAP, ...) are also welcome. But all students are graded based on the same evaluation criteria.
- Copying the assignments of other students is strictly prohibited. “Similar” assignments will be rejected.

tools : igraph

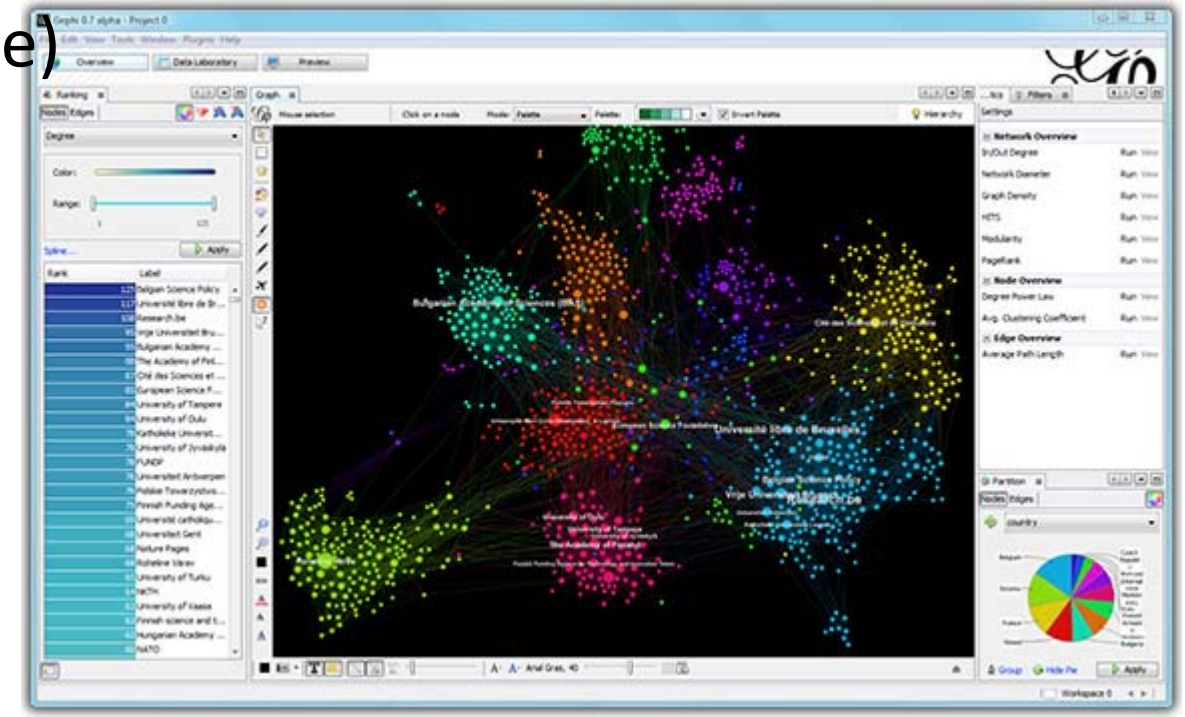
- software for analyzing networks
  - A rich set of functions calculating various structural properties
  - http://igraph.org/



tools : Gephi

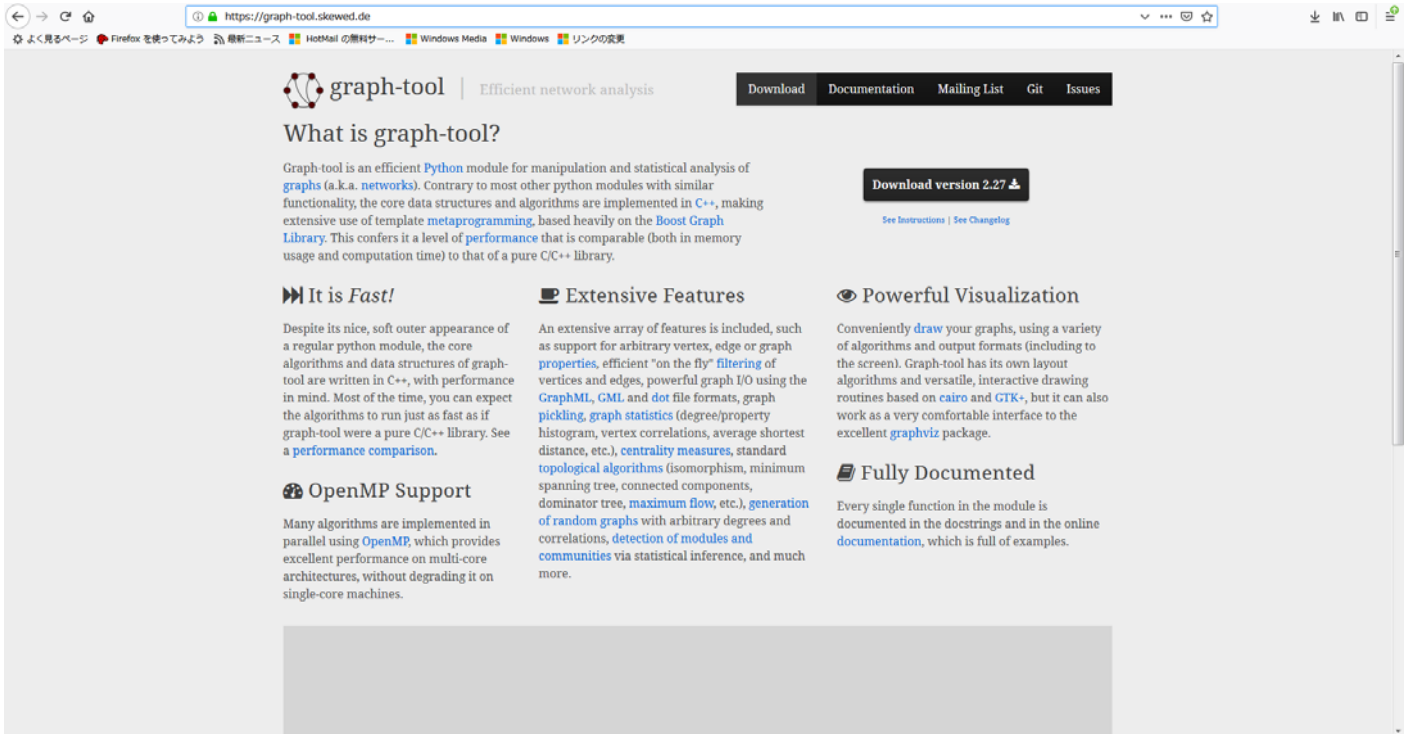
- new software for analyzing networks
  - easy to use, online tutorials available
  - https://gephi.github.io/ (English)
  - http://oss.infoscience.co.jp/gephi/gephi.org/index.html (Japanese)

model environment



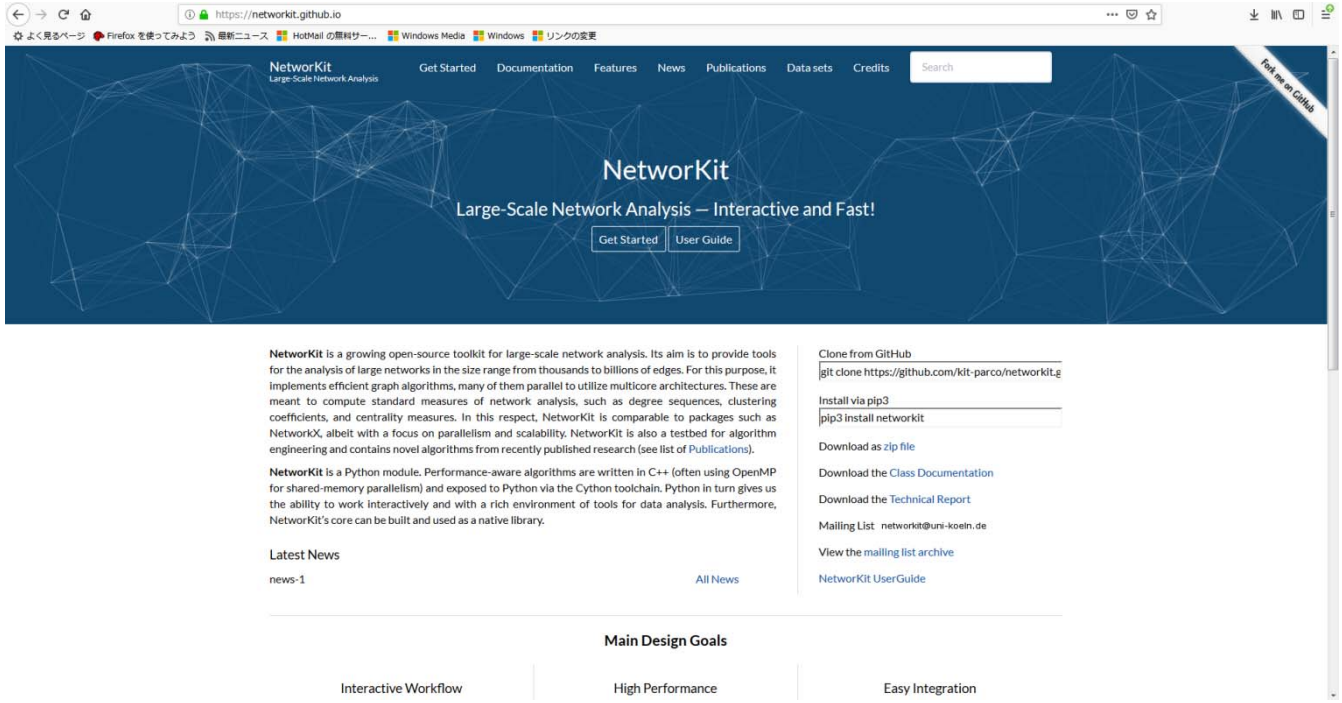
tools: graph-tool

- Python + C++ (fast)
- Support parallelism (OpenMP)
- https://graph-tool.skewed.de/



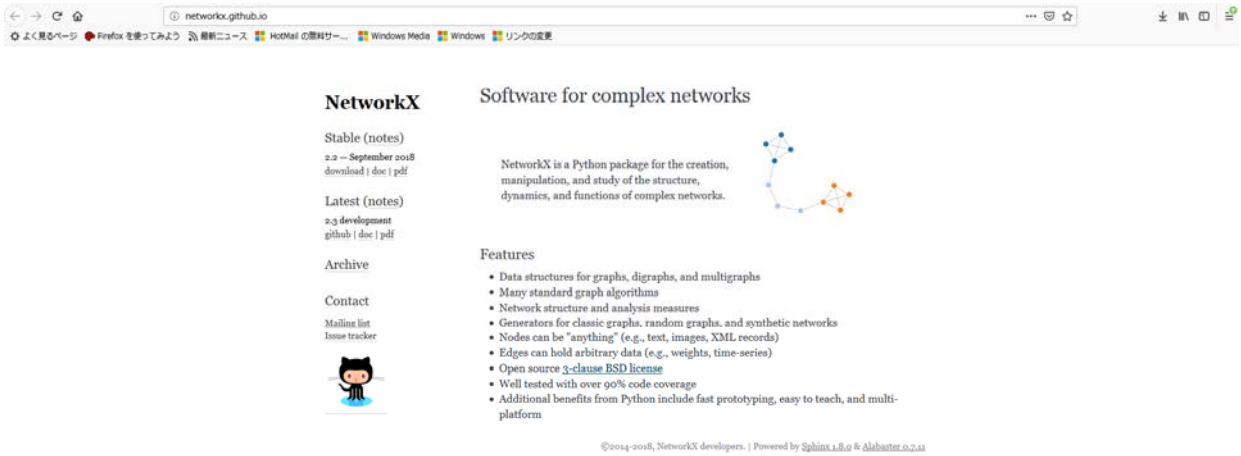
tools : NetworKit

- focuses on performance and integration (with Python, Jupyter Notebook, Gephi and pandas)
- https://networkit.github.io/



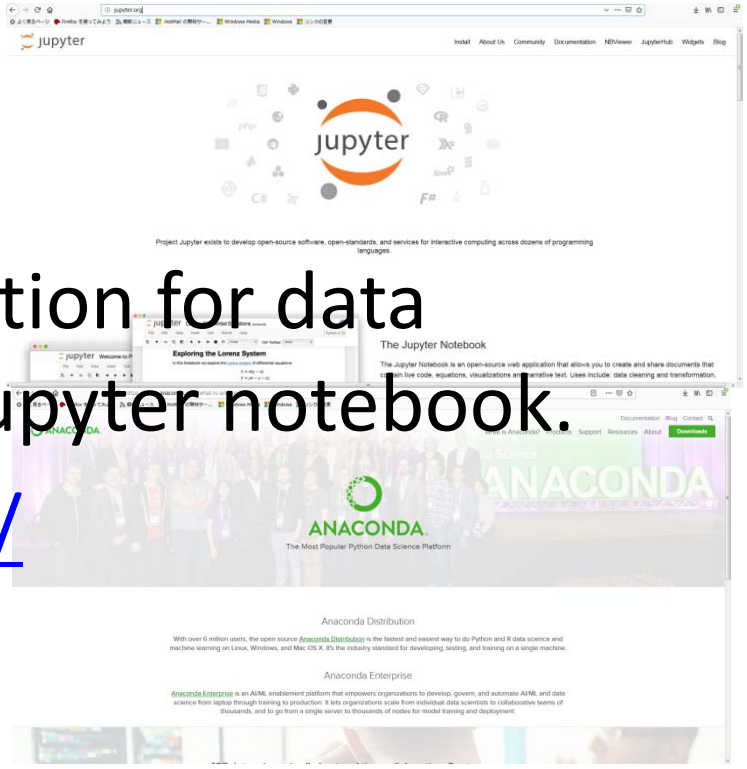
tools : networkX

- Python library for analyzing networks
- easy to install
- http://networkx.github.io/



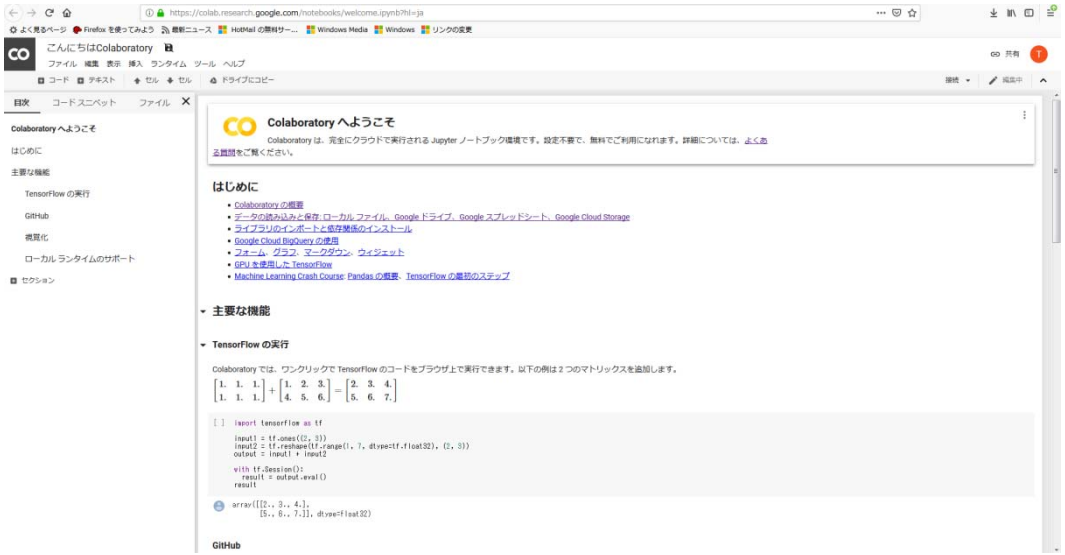
Jupyter notebook

- an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text.
- http://jupyter.org/
- Anaconda (a python distribution for data science platform) contains Jupyter notebook.
- https://www.anaconda.com/



Google colaboratory

- Built on top of Jupyter notebook
- Interactive browser-based environment is available (Google account is required)
- https://colab.research.google.com/



Google colaboratory for network analysis

- Jupyter notebook (as python environment) + networkX (for network analysis) + matplotlib (for plotting / graph drawing)
- Microsoft also provides similar environments https://notebooks.azure.com/