

network *visualization*

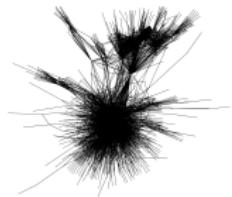
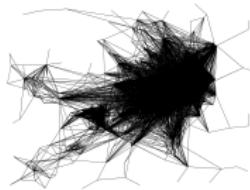
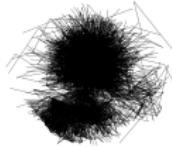
introduction to *network science in Python* (*NetPy*)

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University of Ljubljana
18th Jan 2022

visualization *overview*

network *visualization* with *wiring diagram*

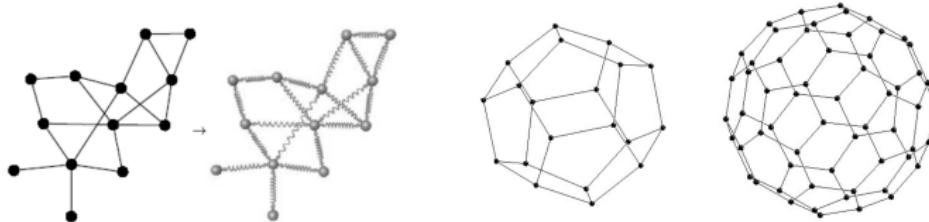
- 1st find *network layout* as node *coordinates* in Euclidean plane etc.
- 2nd *representation* of *network links*? strength, pattern, shape, color etc.
- 3rd *representation* of *network nodes*? size, shape, color, label etc.



similar link lengths, no crossings, displays symmetry, even node distribution etc.

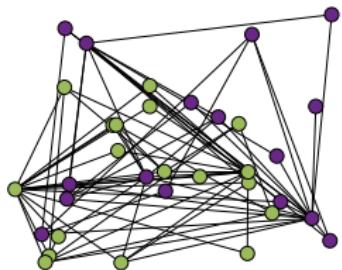
visualization *framework*

- Eades *spring embedded layout* [Ead84]
- Fruchterman-Reingold *force-directed layout* [FR91]
- Kamada-Kawai *graph theoretic layout* [KK89]
- *attractive forces* between *neighbors* using Hooke's law
- *repulsive force* between *nodes* using Coulomb's law
- move nodes thus to *minimize layout energy*

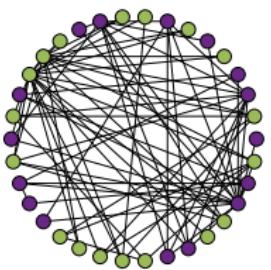


pleasing with similar link lengths, symmetry & even distribution

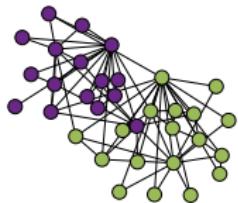
visualization *karate*



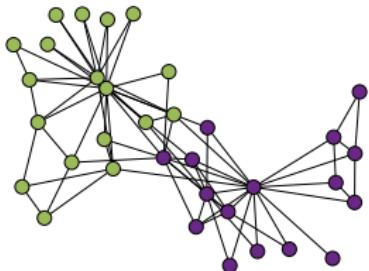
random layout



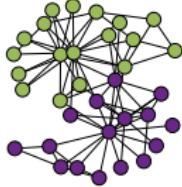
circular layout



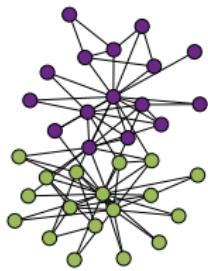
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]

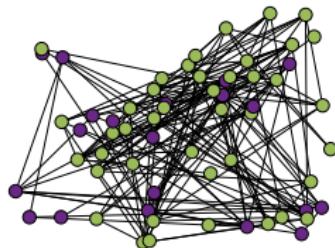


Kamada-Kawai layout [KK89]

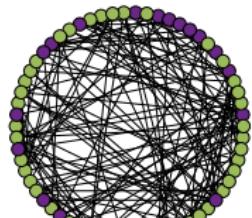


LGL layout [ADWM04]

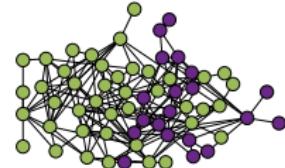
visualization *dolphins*



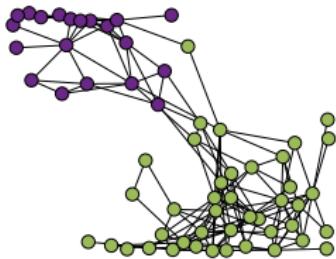
random layout



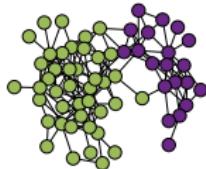
circular layout



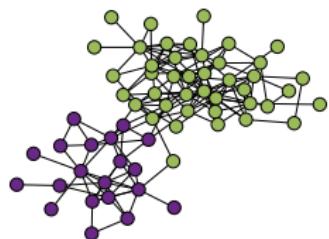
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]

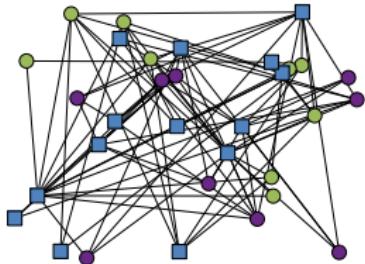


Kamada-Kawai layout [KK89]

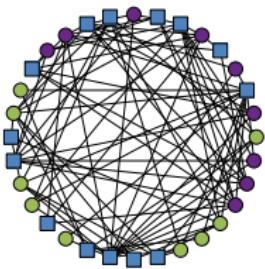


LGL layout [ADWM04]

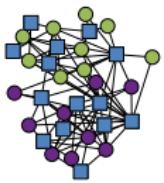
visualization *women*



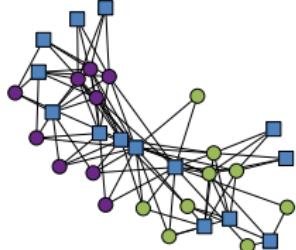
random layout



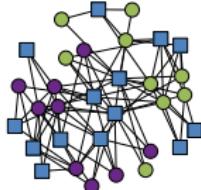
circular layout



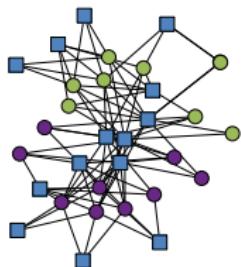
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]



Kamada-Kawai layout [KK89]



LGL layout [ADWM04]

visualization *references*

-  Alex T. Adai, Shailesh V. Date, Shannon Wieland, and Edward M. Marcotte.
LGL: Creating a map of protein function with an algorithm for visualizing very large biological networks.
J. Mol. Biol., 340(1):179–190, 2004.
-  Peter Eades.
A heuristic for graph drawing.
Congressus Numerantium, 42:149–160, 1984.
-  Thomas M. J. Fruchterman and Edward M. Reingold.
Graph drawing by force-directed placement.
Softw: Pract. Exper., 21(11):1129–1164, 1991.
-  Helen Gibson, Joe Faith, and Paul Vickers.
A survey of two-dimensional graph layout techniques for information visualisation.
Infor. Visual., 12(3-4):324–357, 2013.
-  Tomihisa Kamada and Satoru Kawai.
An algorithm for drawing general undirected graphs.
Inform. Process. Lett., 31(1):7–15, 1989.
-  Stephen G. Kobourov.
Force-directed drawing algorithms.
In Roberto Tamassia, editor, *Handbook of Graph Drawing and Visualization*, pages 383–408. CRC Press, 2013.
-  Kwan-Liu Ma and Chris W. Muelder.
Large-scale graph visualization and analytics.
Computer, 46(7):39–46, 2013.