Network Visualizations

Or: Relationships–It's complicated.

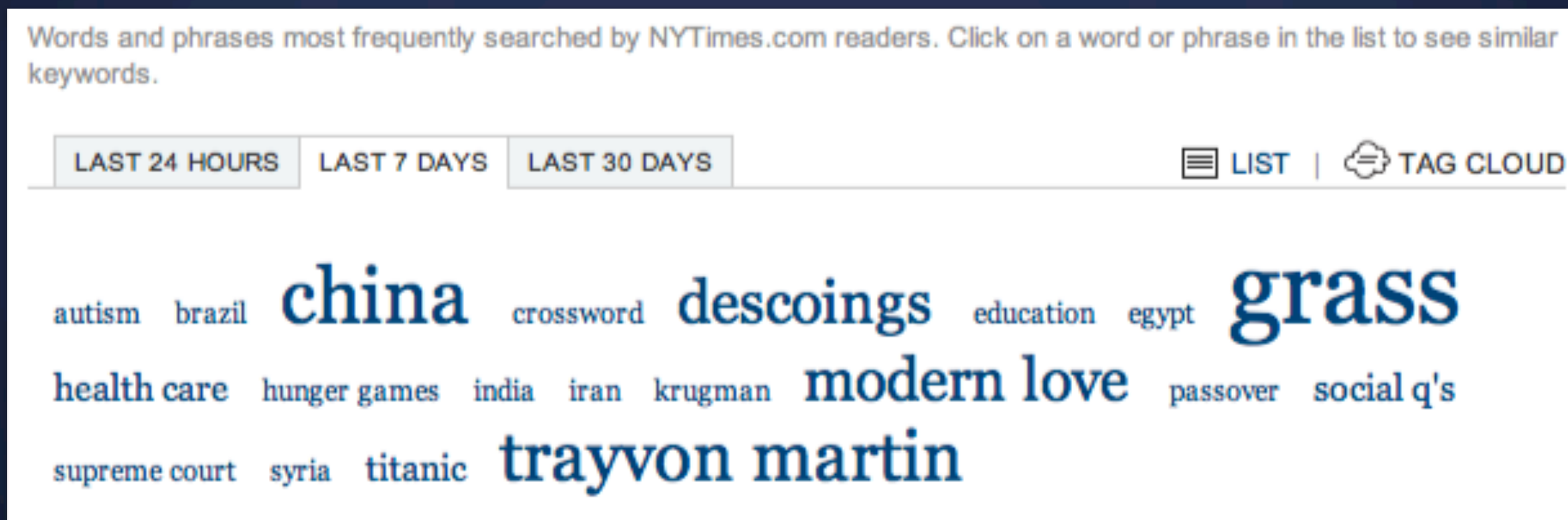
April 10, 2012 – Michael Porath

Text Visualization

Addendum

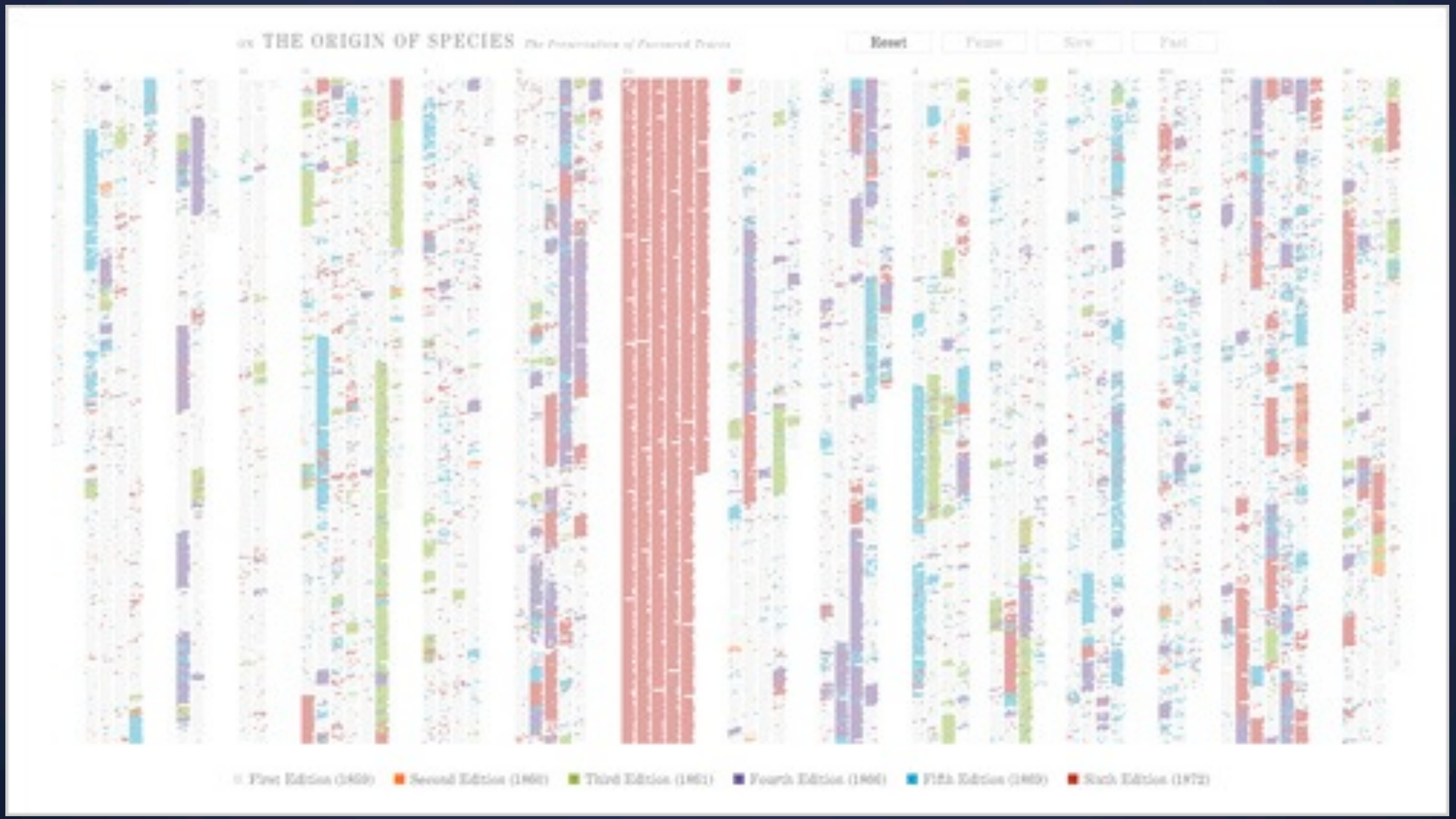
Word-Level Visualizations

NY Times most searched terms



Document-Level Visualizations

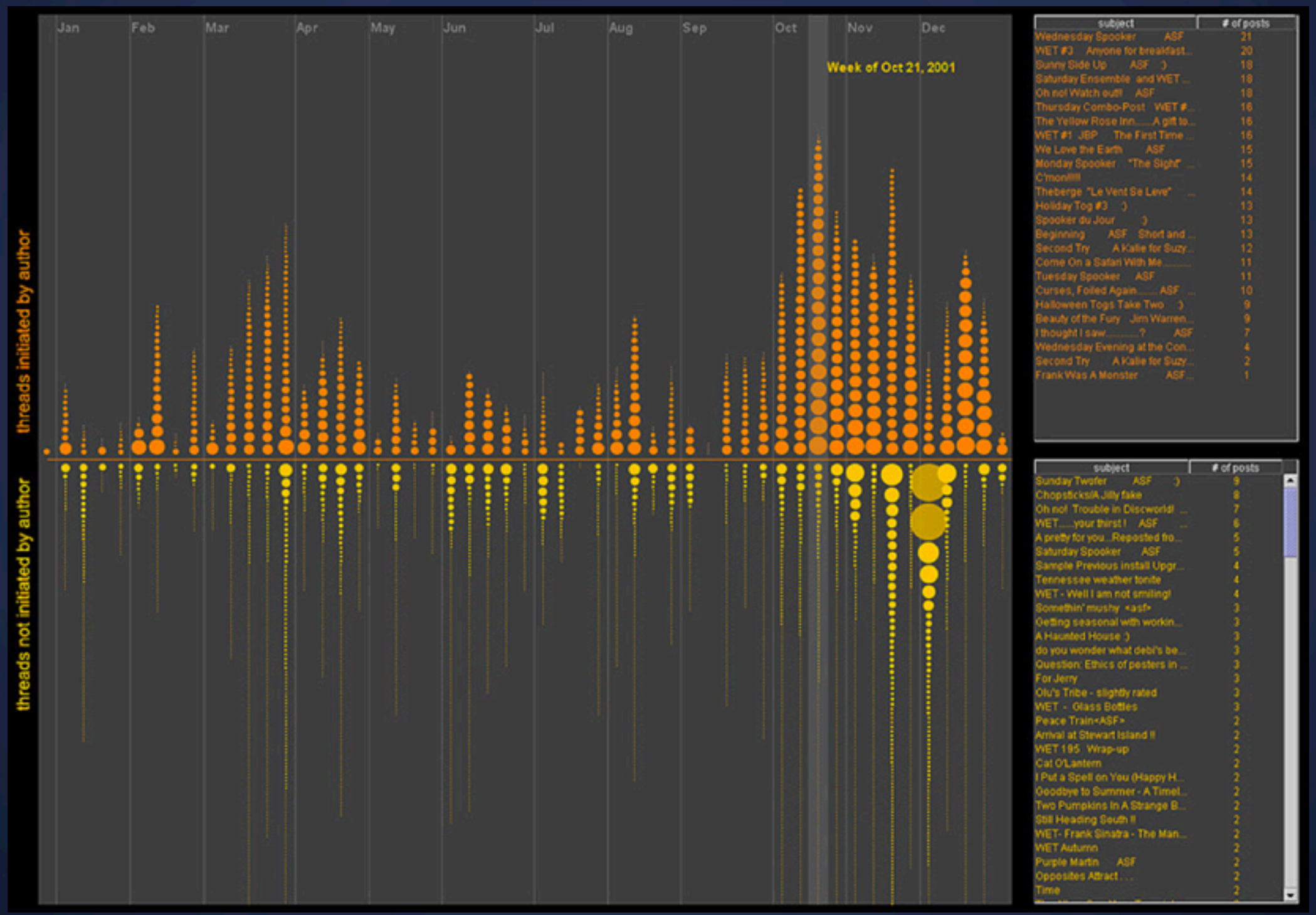
On the Origin of Species: The Preservation of Favoured Traces



http://benfry.com/traces/

Collection-Level Visualizations

Newsgroup usage



Newsgroup crowds and authorlines: Visualizing the activity of individuals in conversational cyberspaces (Viegas)

Project Proposal Feedback

Project Proposal Feedback

- Questions?

Project Proposal Feedback

- Questions?
- Our project visualizes *[your problem space]*.
  It can be used by *[your target audience]*
  ... to *[analyze / communicate]*
  ... *[some more detailed description]*.

Network Visualizations

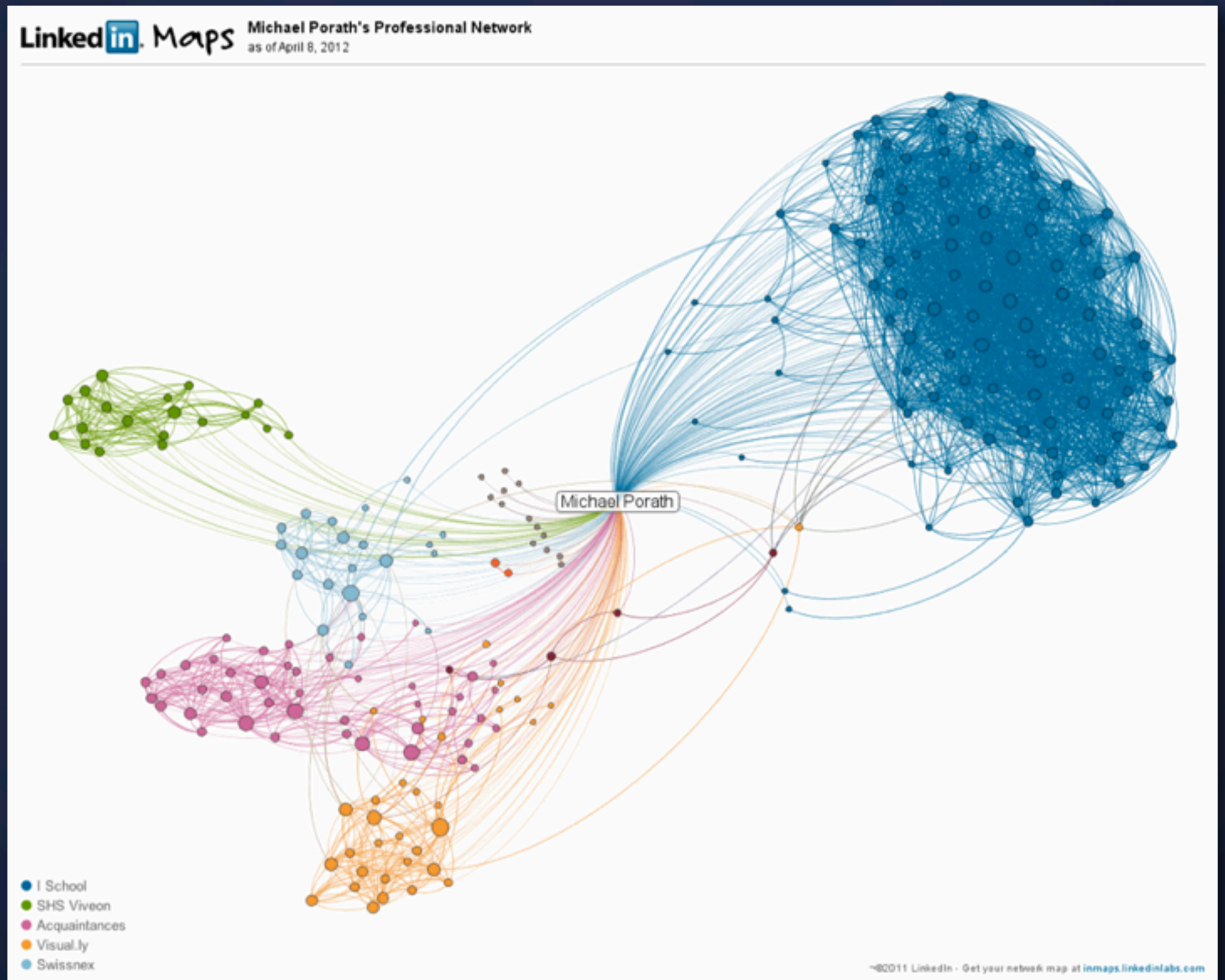
Some Examples

Social Networks

The obvious

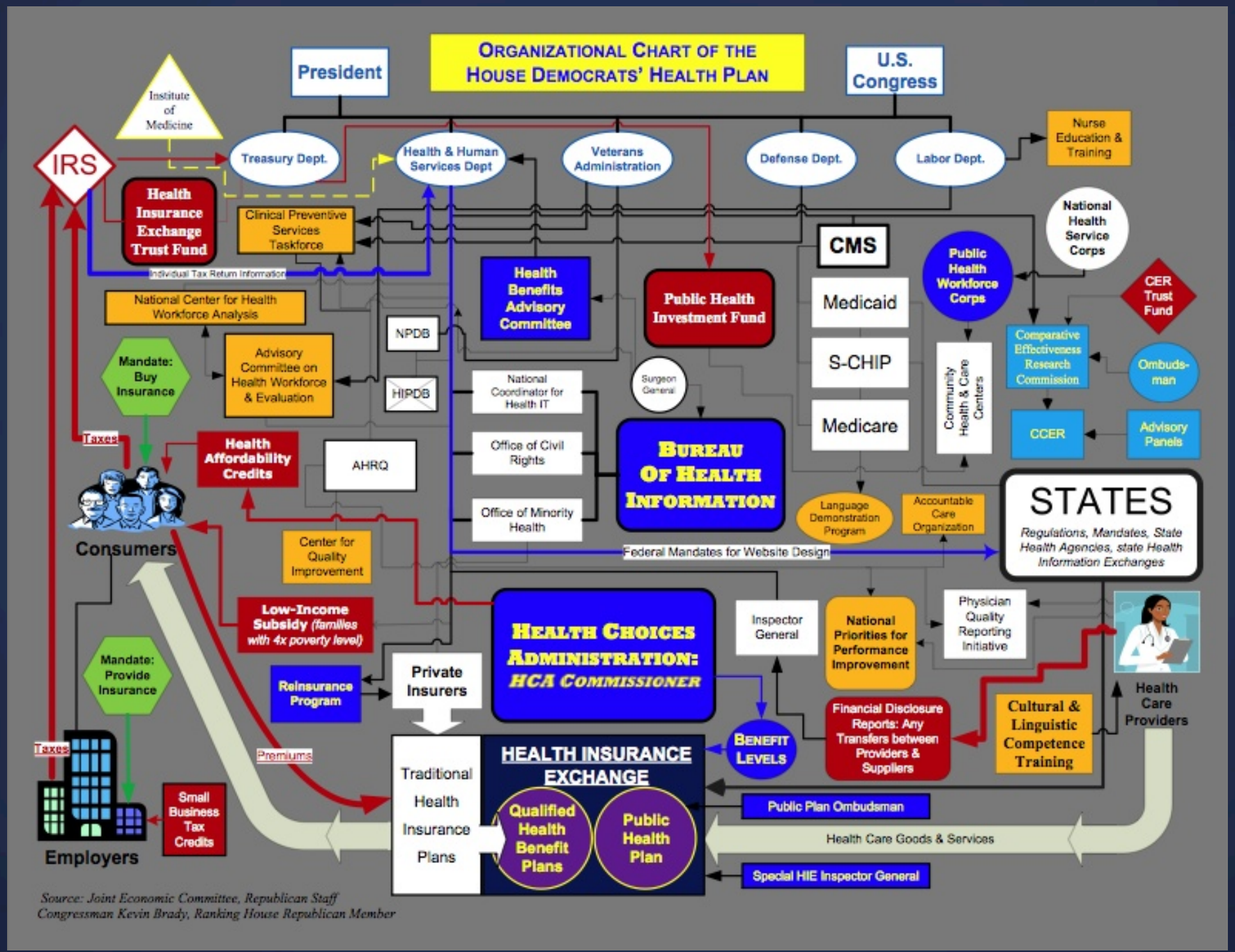
Social Networks

Personalized

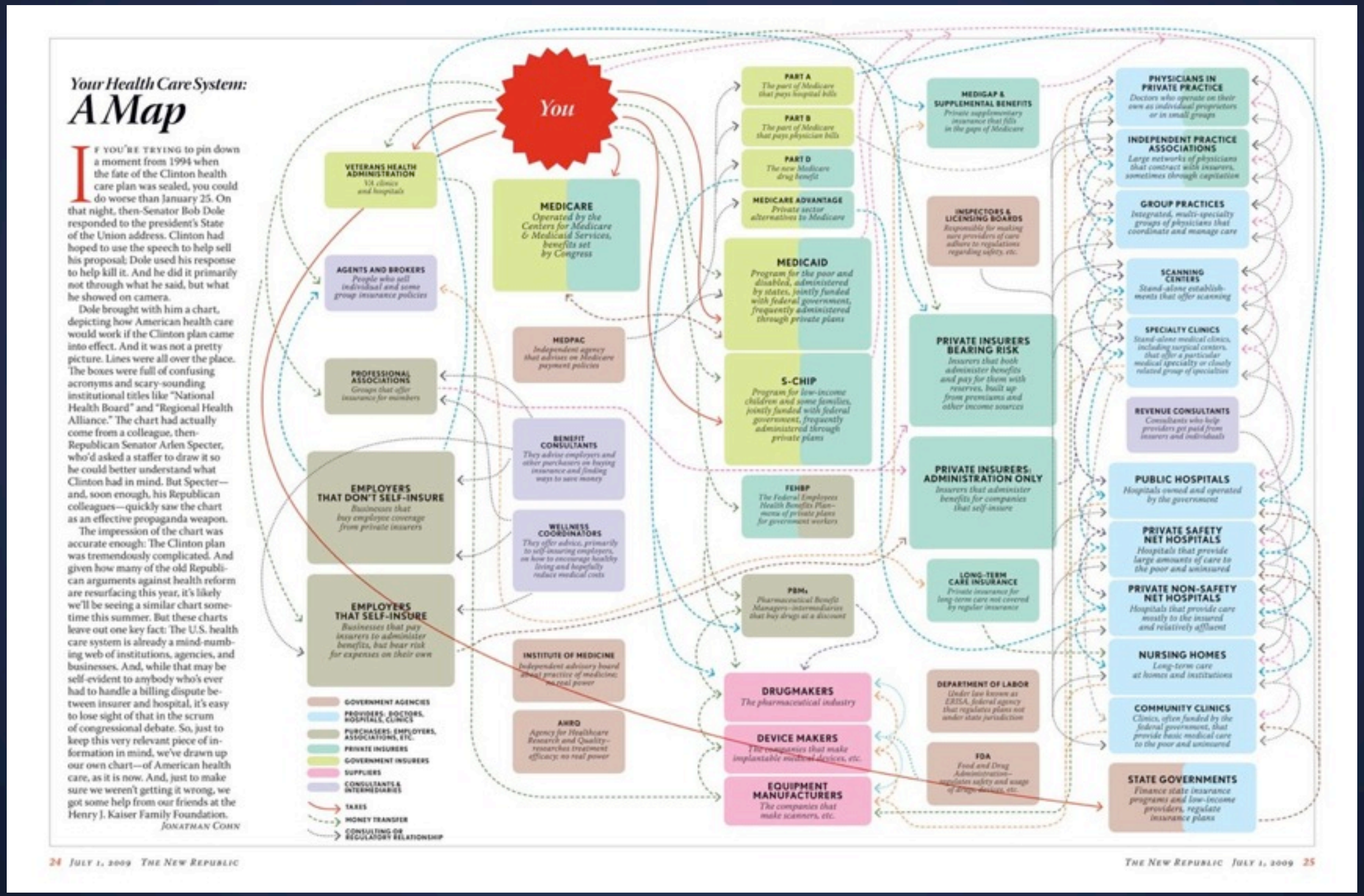


http://inmaps.linkedinlabs.com/

Remember this?



Alternative Visualization



Your Health Care System:
A Map

IF YOU'RE TRYING to pin down a moment from 1994 when the fate of the Clinton health care plan was sealed, you could do worse than January 25. On that night, then-Senator Bob Dole responded to the president's State of the Union address. Clinton had hoped to use the speech to help sell his proposal; Dole used his response to help kill it. And he did it primarily not through what he said, but what he showed on camera.

Dole brought with him a chart, depicting how American health care would work if the Clinton plan came into effect. And it was not a pretty picture. Lines were all over the place. The boxes were full of confusing acronyms and scary-sounding institutional titles like "National Health Board" and "Regional Health Alliance." The chart had actually come from a colleague, then-Republican Senator Arlen Specter, who'd asked a staffer to draw it so he could better understand what Clinton had in mind. But Specter—and, soon enough, his Republican colleagues—quickly saw the chart as an effective propaganda weapon.

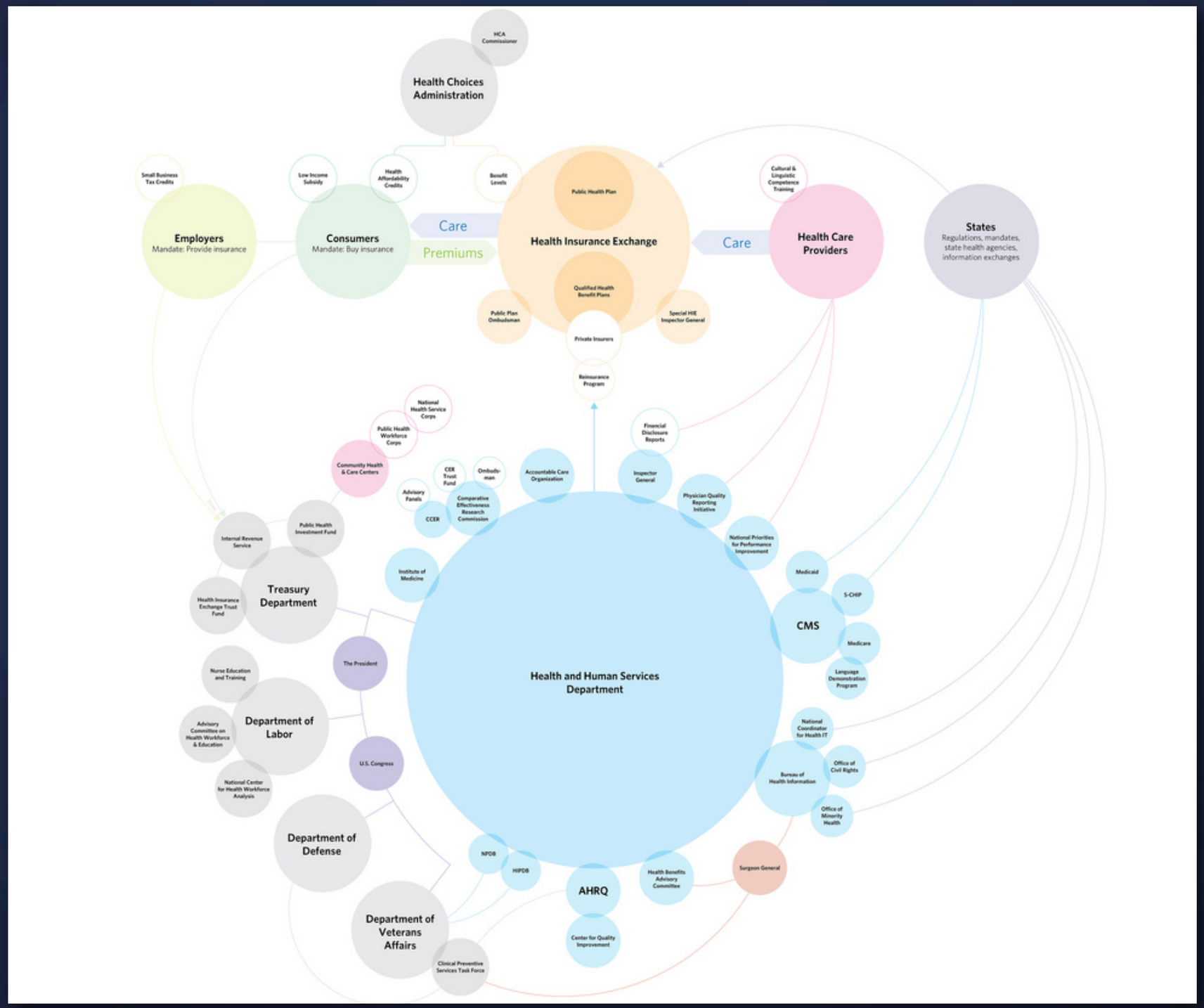
The impression of the chart was accurate enough: The Clinton plan was tremendously complicated. And given how many of the old Republican arguments against health reform are resurfacing this year, it's likely we'll be seeing a similar chart sometime this summer. But these charts leave out one key fact: The U.S. health care system is already a mind-numbing web of institutions, agencies, and businesses. And, while that may be self-evident to anybody who's ever had to handle a billing dispute between insurer and hospital, it's easy to lose sight of that in the scrum of congressional debate. So, just to keep this very relevant piece of information in mind, we've drawn up our own chart—of American health care, as it is now. And, just to make sure we weren't getting it wrong, we got some help from our friends at the Henry J. Kaiser Family Foundation.

JONATHAN COHN

http://voices.washingtonpost.com/ezra-klein/assets_c/2009/07/HealthCareMap.html

Alternative

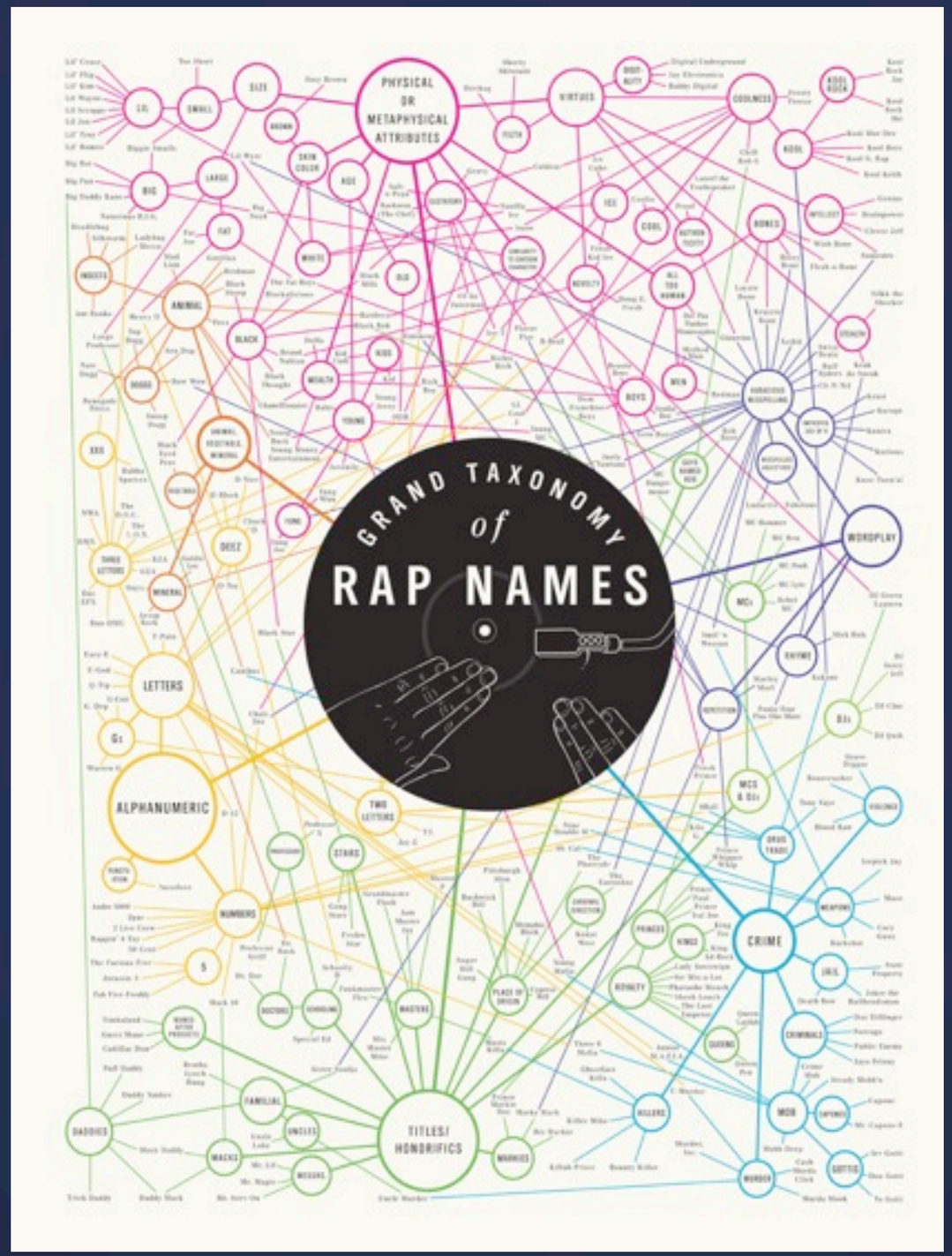
"Do not fuck with graphic designers"



http://www.flickr.com/photos/robertpalmer/3743826461/

Taxonomies

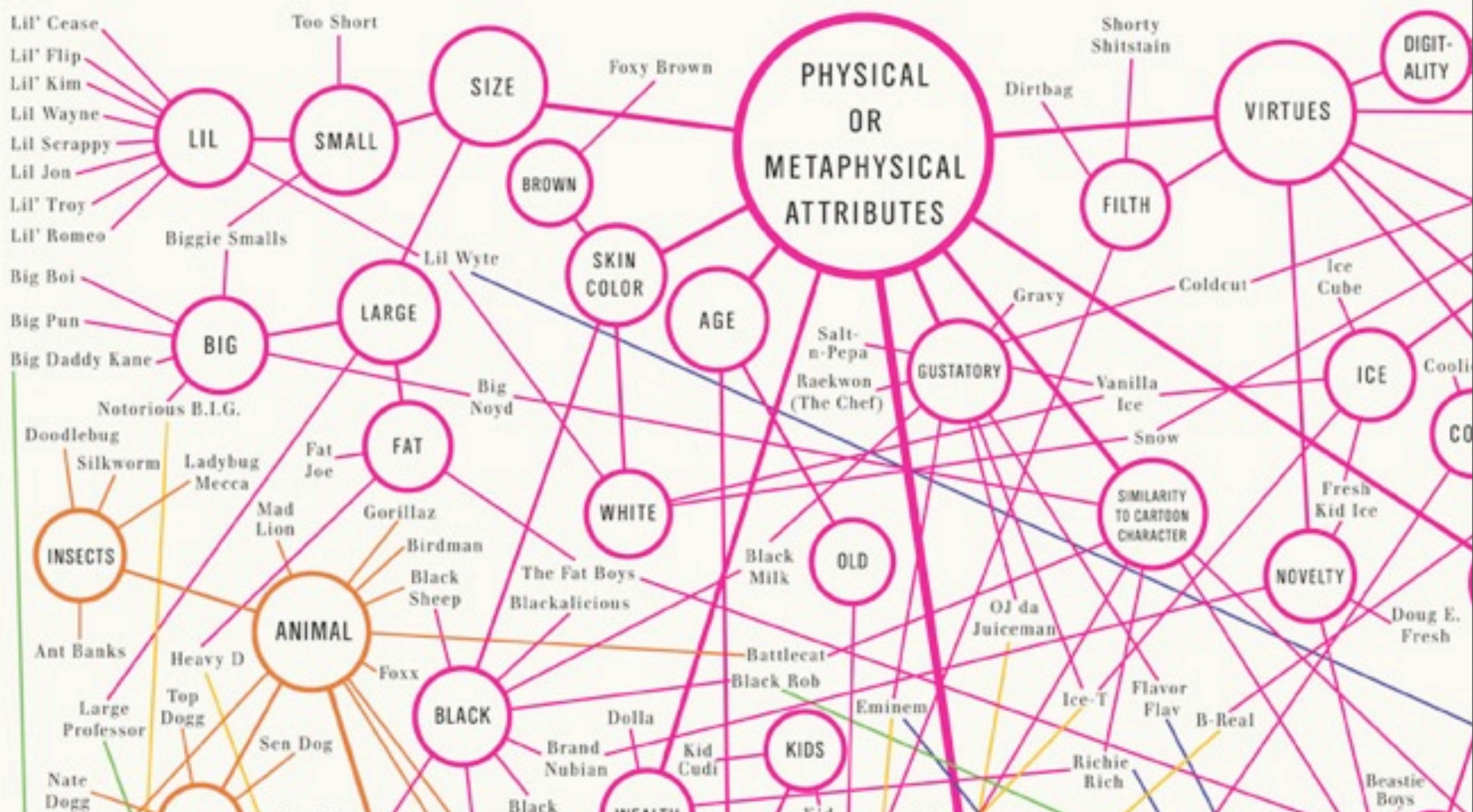
Rap Names



http://worldfamousdesignjunkies.com/wp-content/uploads/2010/09/wfdj_popchartlab_thegrandtaxonomyofrapnames.jpg

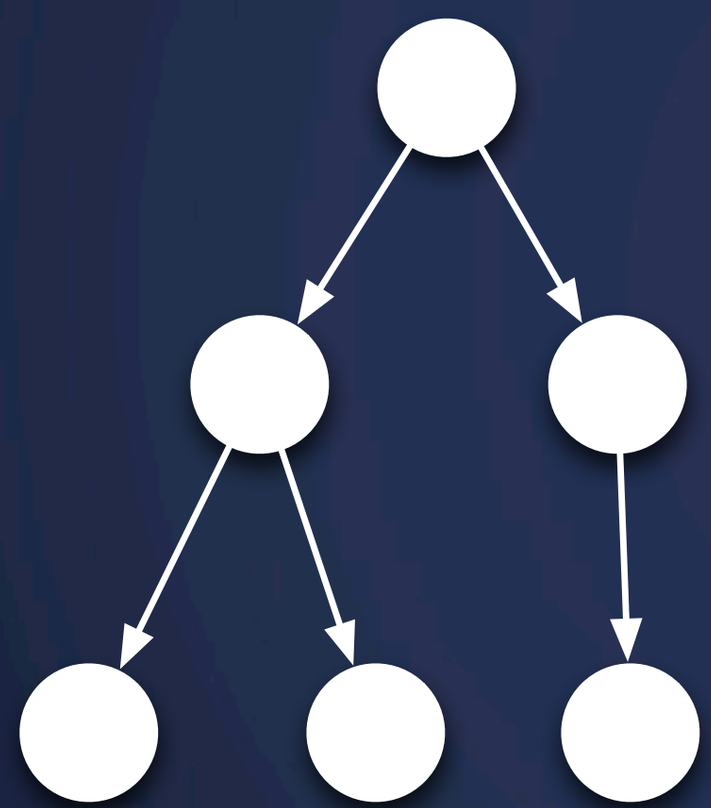
Taxonomies

Rap Names

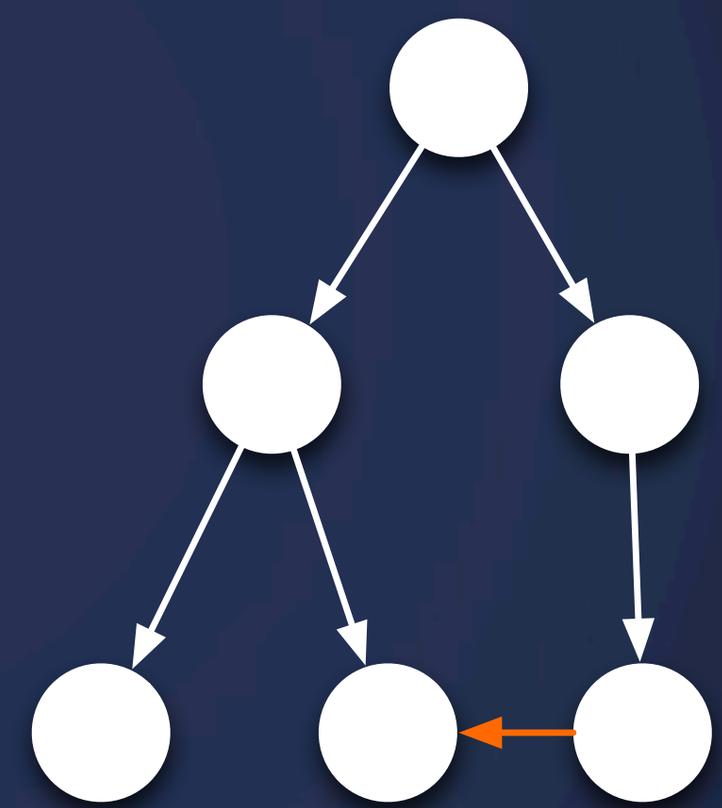


Properties of networks

Graphs, trees, and networks



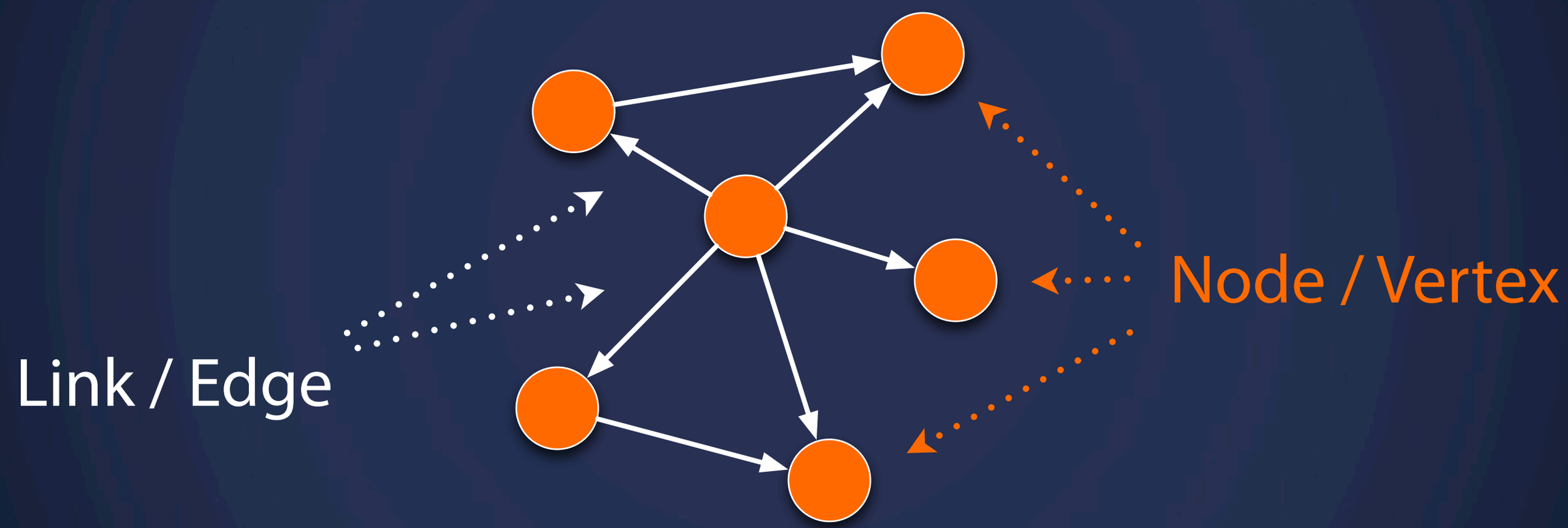
Tree



Network

Terminology

Nodes and Links (thus, Node-Link graph)



Properties

Directionality and Symmetry

undirected edges

directed edges

bi-directional,
symmetrical edges

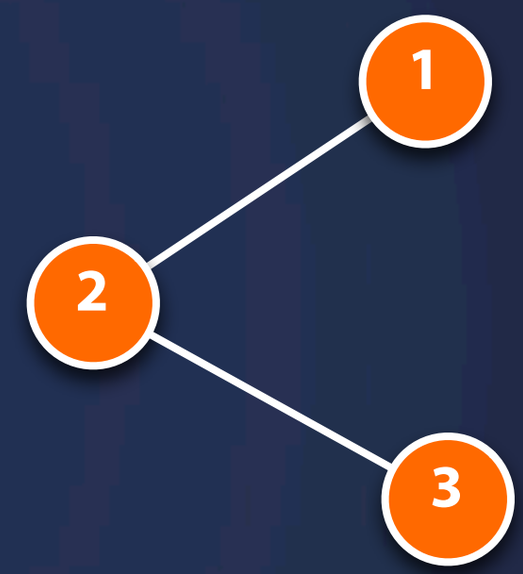
bi-directional,
asymmetrical edges

Graph representation

Adjacency matrix

	1	2	3
1	0	1	0
2	1	0	1
3	0	1	0

Adjacency matrix



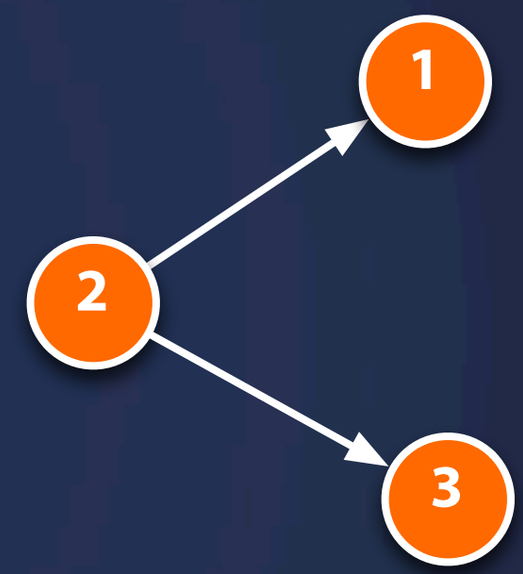
Visualization

Graph representation

Adjacency matrix; directed edges

	1	2	3
1	0	0	0
2	1	0	1
3	0	0	0

Adjacency matrix



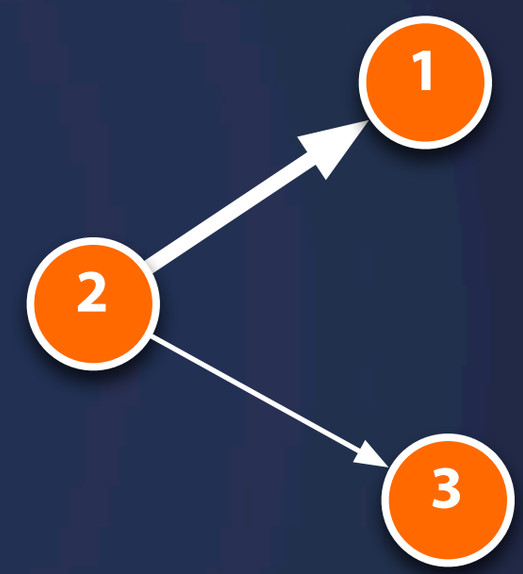
Visualization

Graph representation

Adjacency matrix; directed edges

	1	2	3
1	0	0	0
2	3	0	1
3	0	0	0

Adjacency matrix

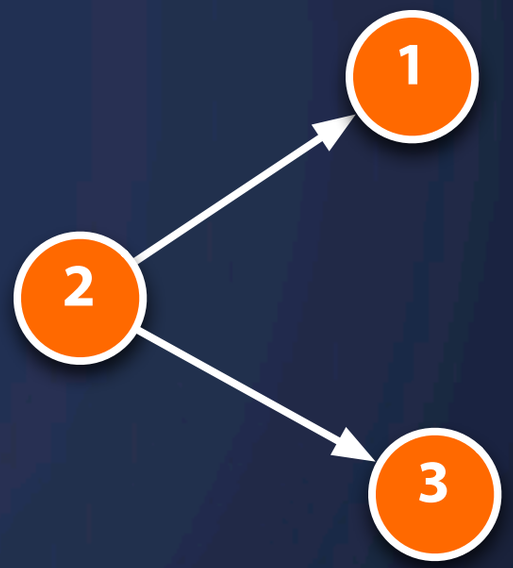


Visualization

Topology

In-degree / Out-degree

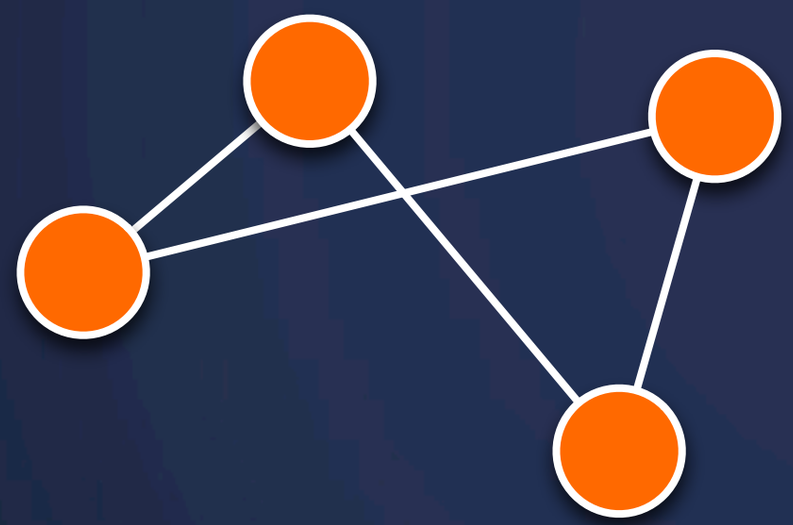
	1	2	3
In-degree	1		1
Out-degree		2	



Topology

Planar graphs

Graphs that can be laid out without edge crossings

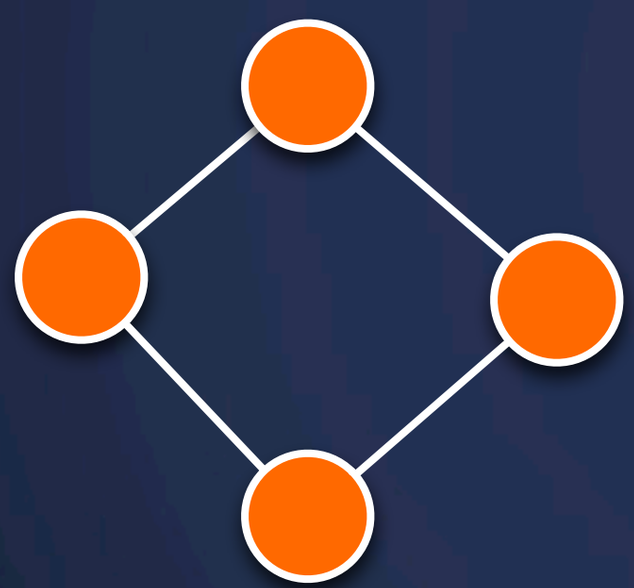


Which one is planar?

Topology

Planar graphs

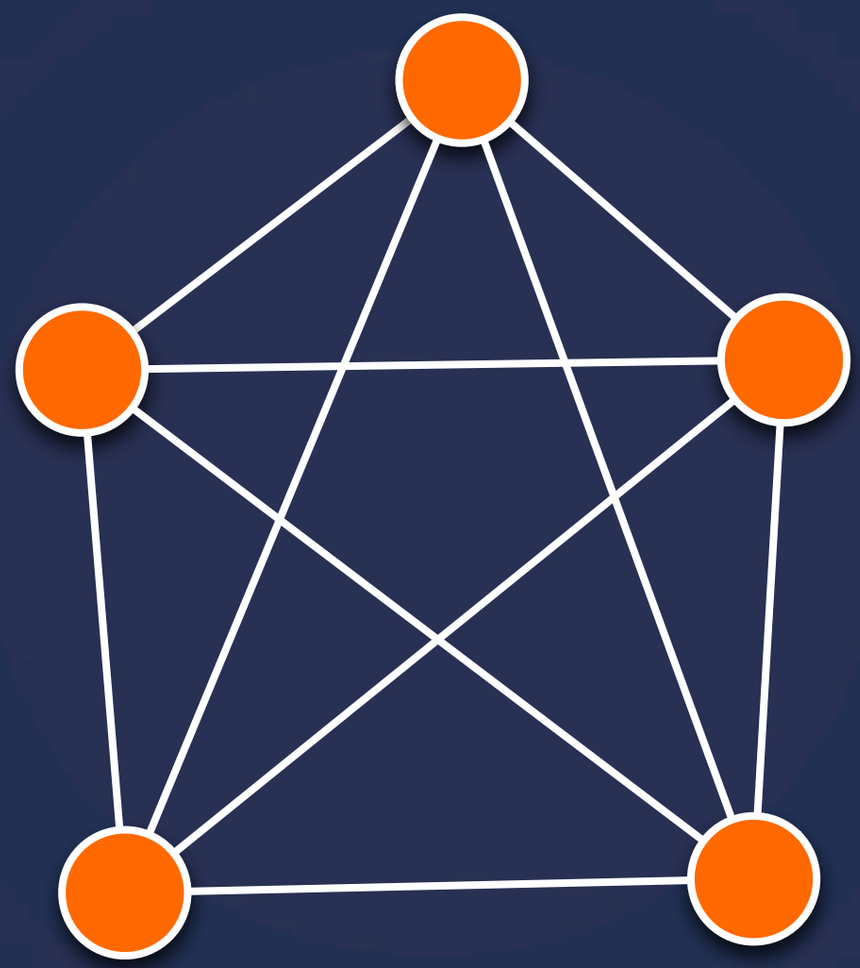
Graphs that can be laid out without edge crossings



Both are.

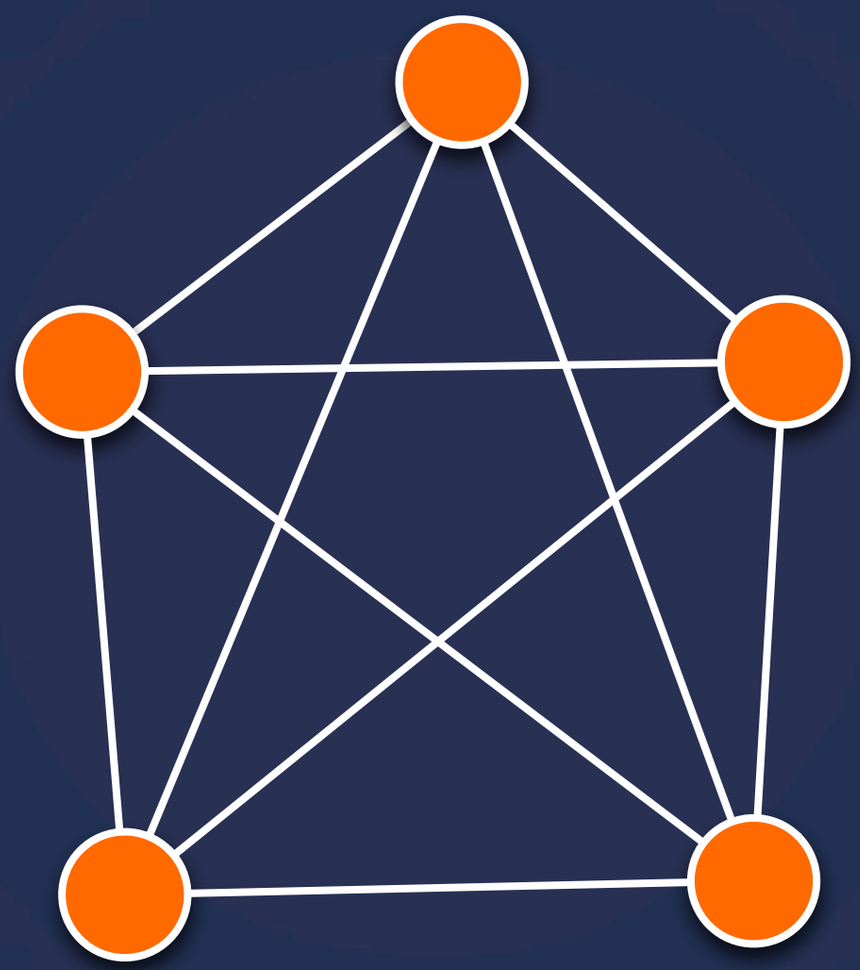
Topology

Planar graphs



Topology

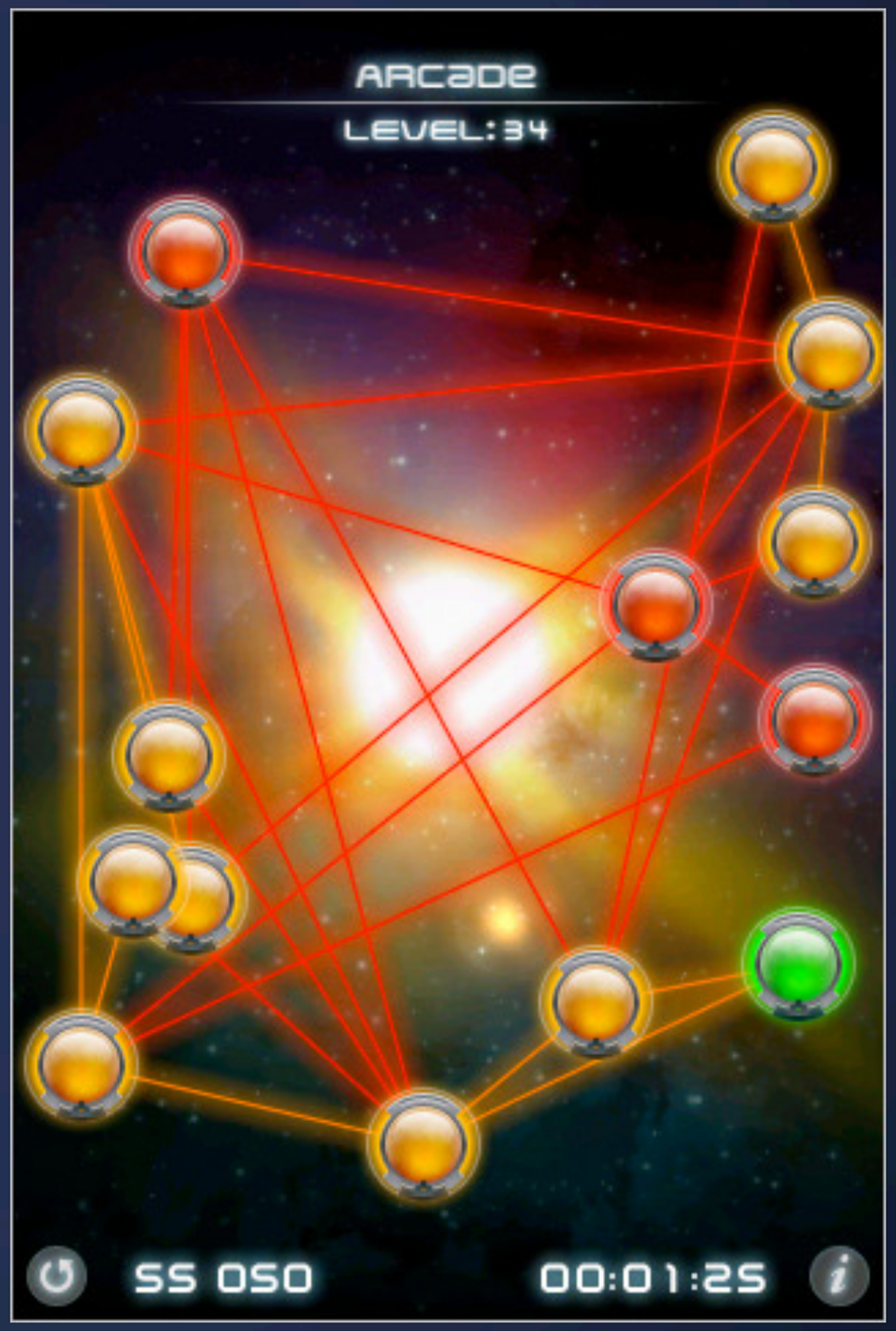
Planar graphs



Non-planar

Topology

Planar graphs... are awesome!



Web app,

iPhone app

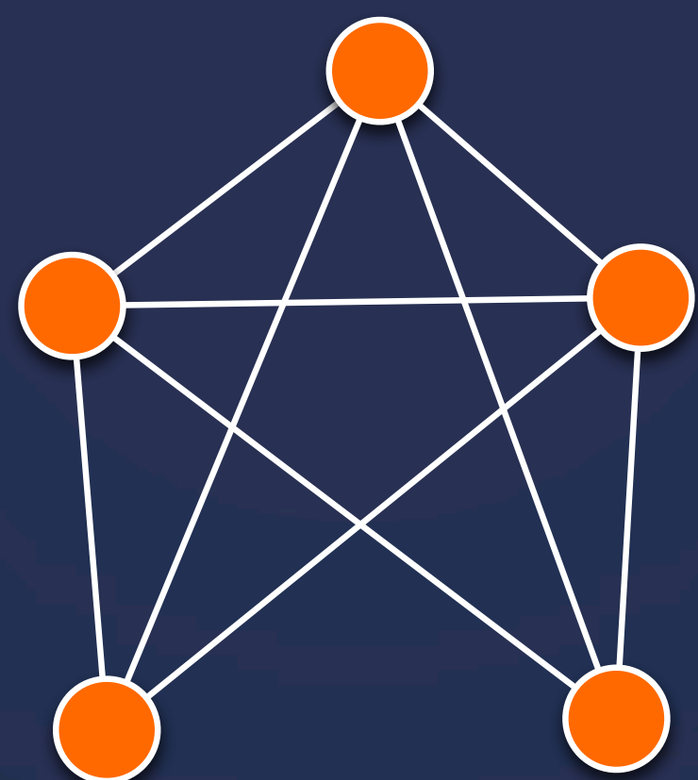
http://www.planarity.net

Visualization Challenges

What are the issues visualizing networks?

Minimize

- edge crossings
- area
- line bends
- line slopes
- total edge length
- max edge length
- edge length variance



Maximize

- smallest angle between edges
- symmetry

Visualization Challenges

Ben Shneiderman's criteria

1. Every node is visible
2. For every node you can count the degree
3. You can follow every link from source to destination
4. Clusters and outliers are identifiable

Solutions

... to the issues

How do we draw the nodes?

How do we draw the links?

How do we lay out the graph?

Nodes and Edges

How do we draw the nodes?

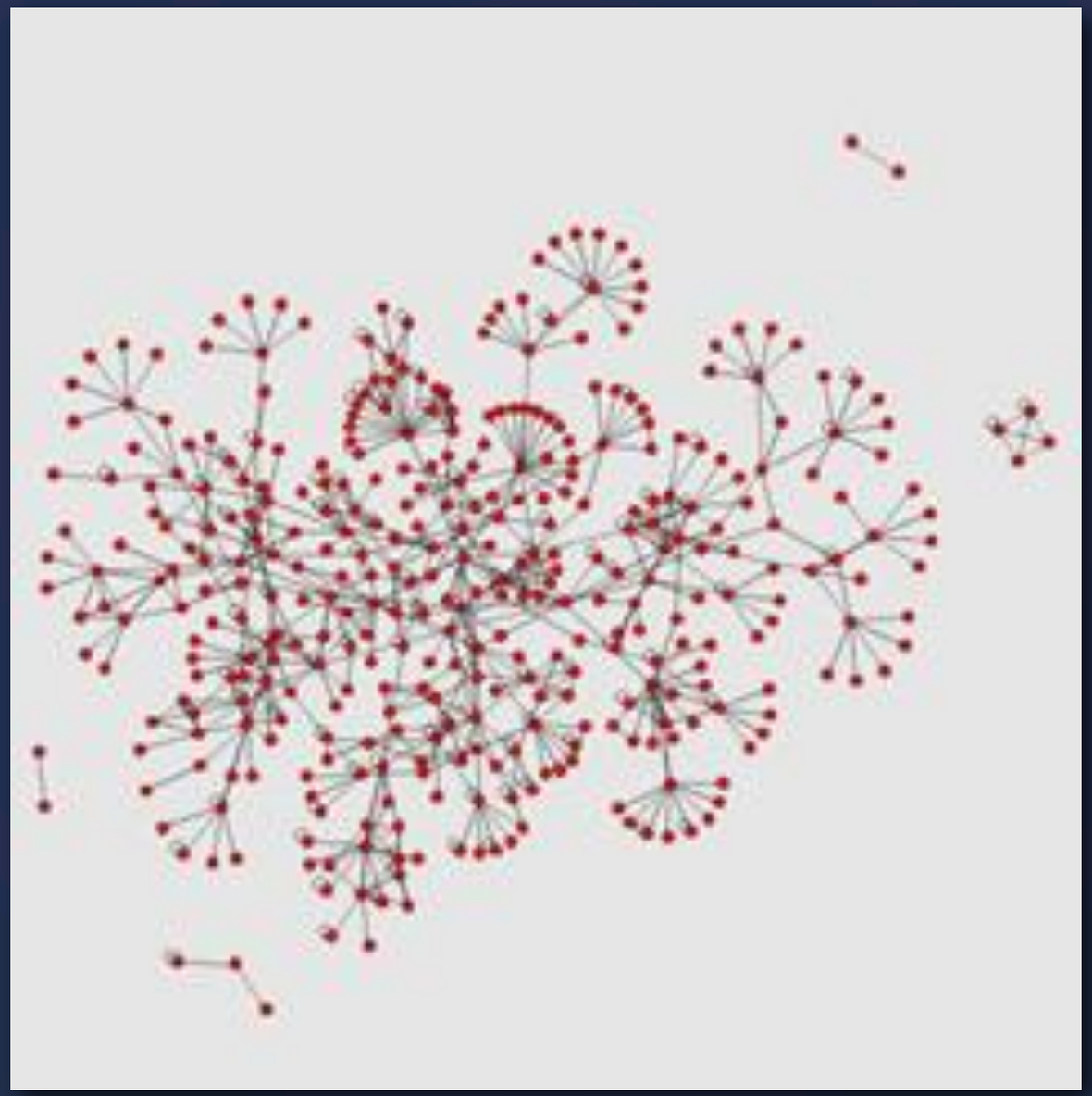
Shape
Color
Size
Location
Label

How do we draw the links?

Color
Size
Label
Form

Layout Heuristics

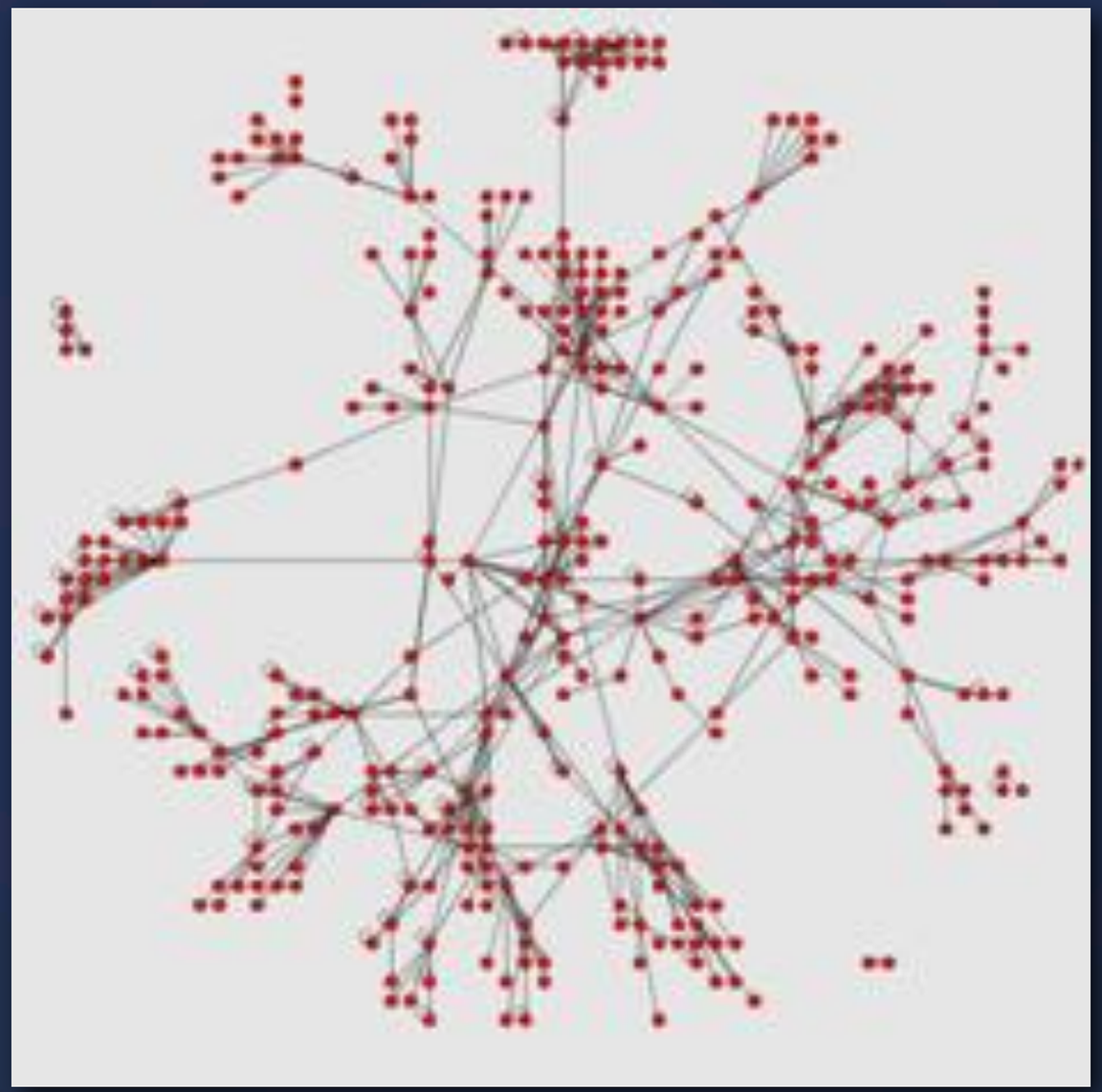
Planar



http://guess.wikispot.org/Laying_out_Graphs?action=Files&do=view&target=spring.jpg

Layout Heuristics

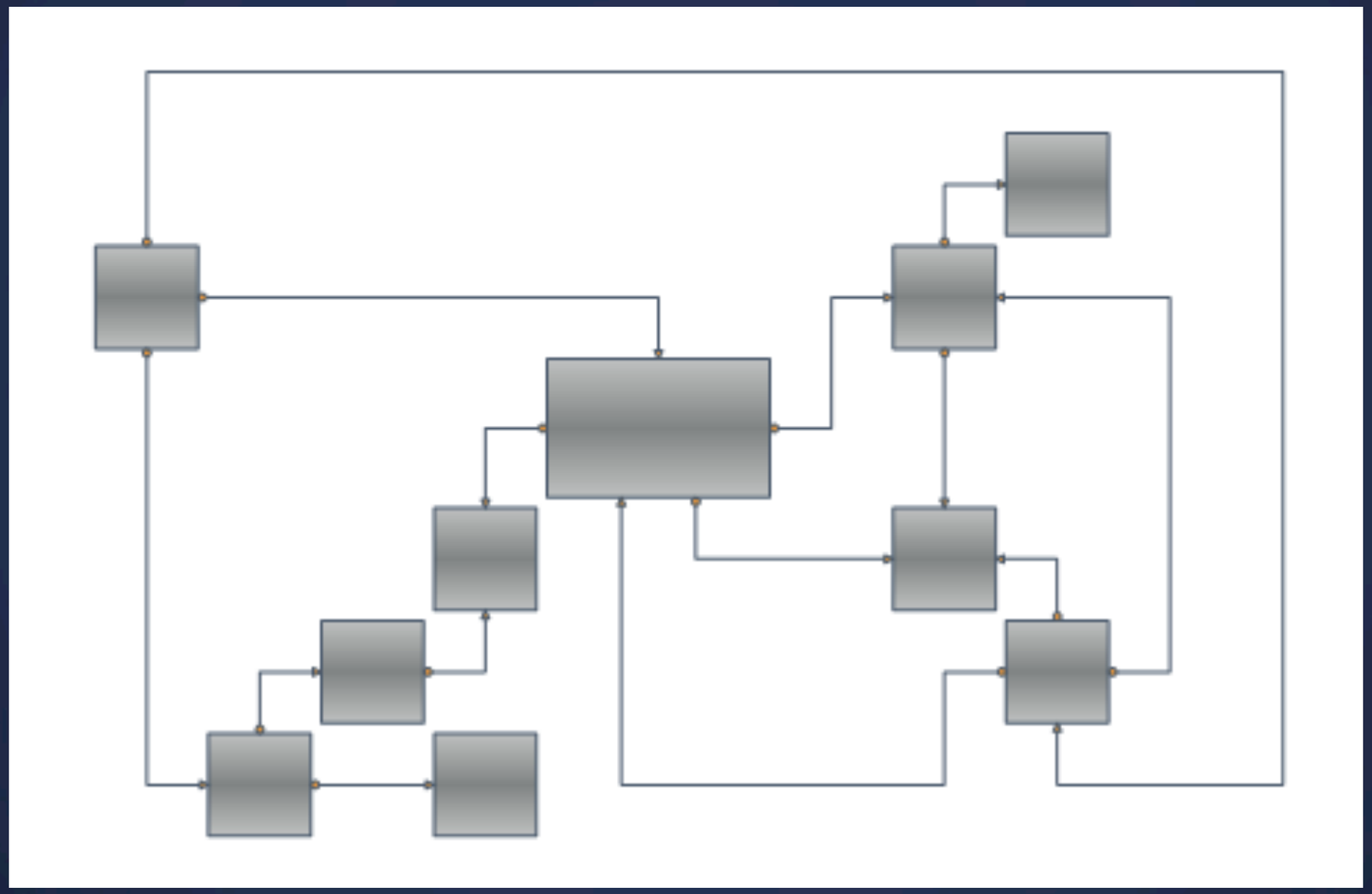
Grid-based



http://guess.wikispot.org/Laying_out_Graphs?action=Files&do=view&target=fr.jpg

Layout Heuristics

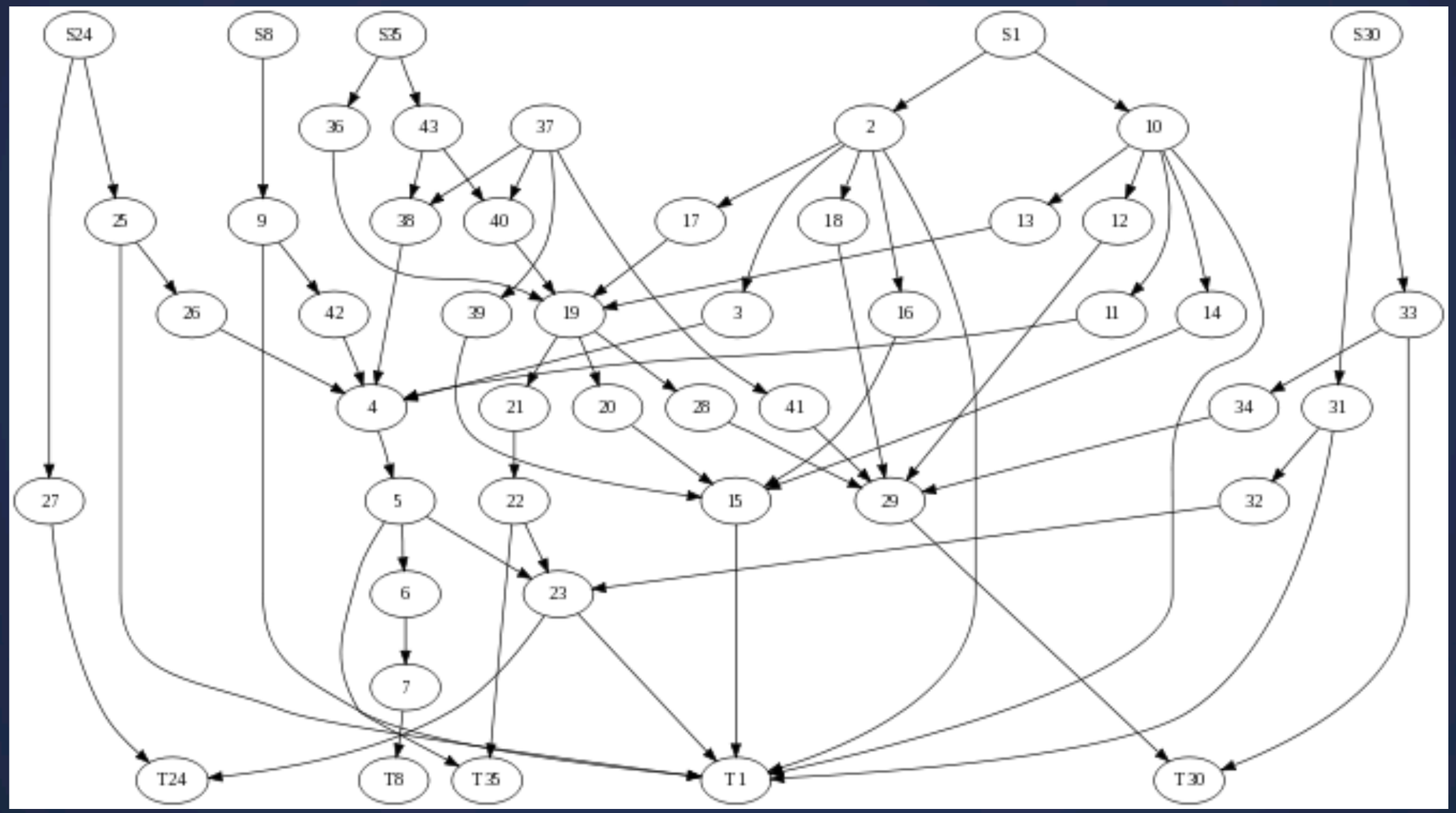
Orthogonal



http://downloads.nevron.com/company/WhitePaperOrthogonalGraphLayout.pdf

Layout Heuristics

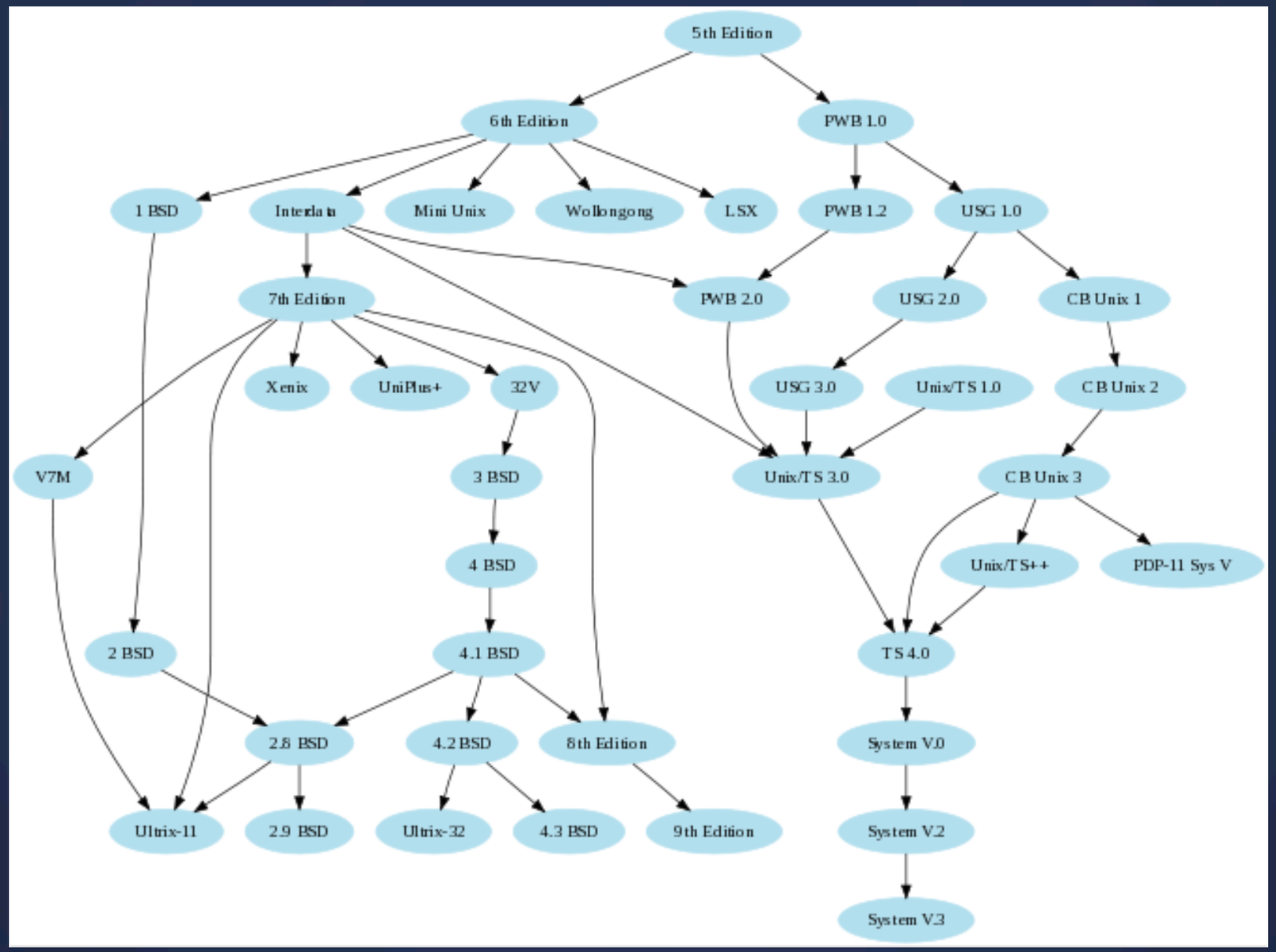
Curved lines



http://www.graphviz.org/Gallery/directed/world.html

Layout Heuristics

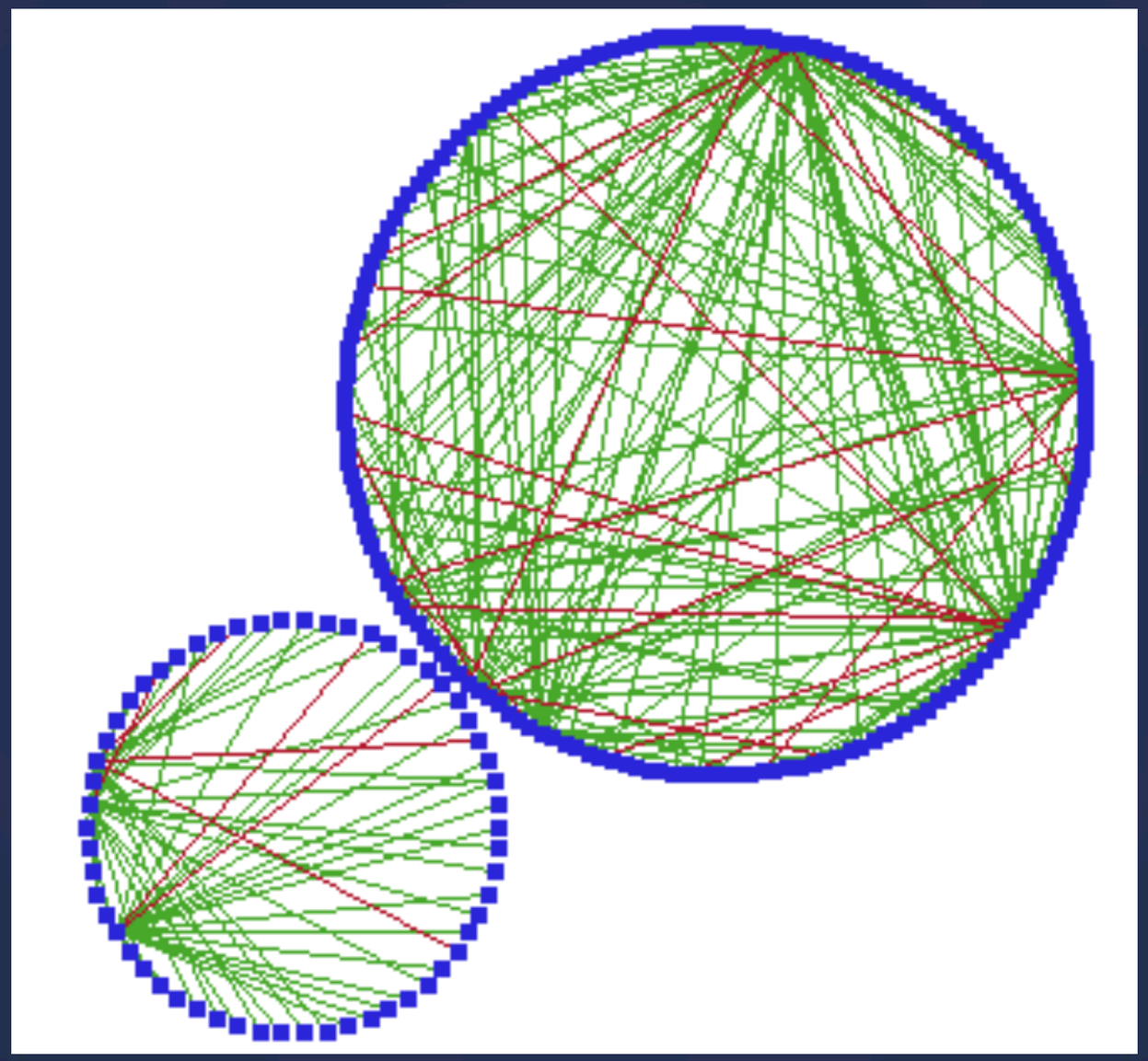
Hierarchies



http://www.graphviz.org/Gallery/directed/unix.html

Layout Heuristics

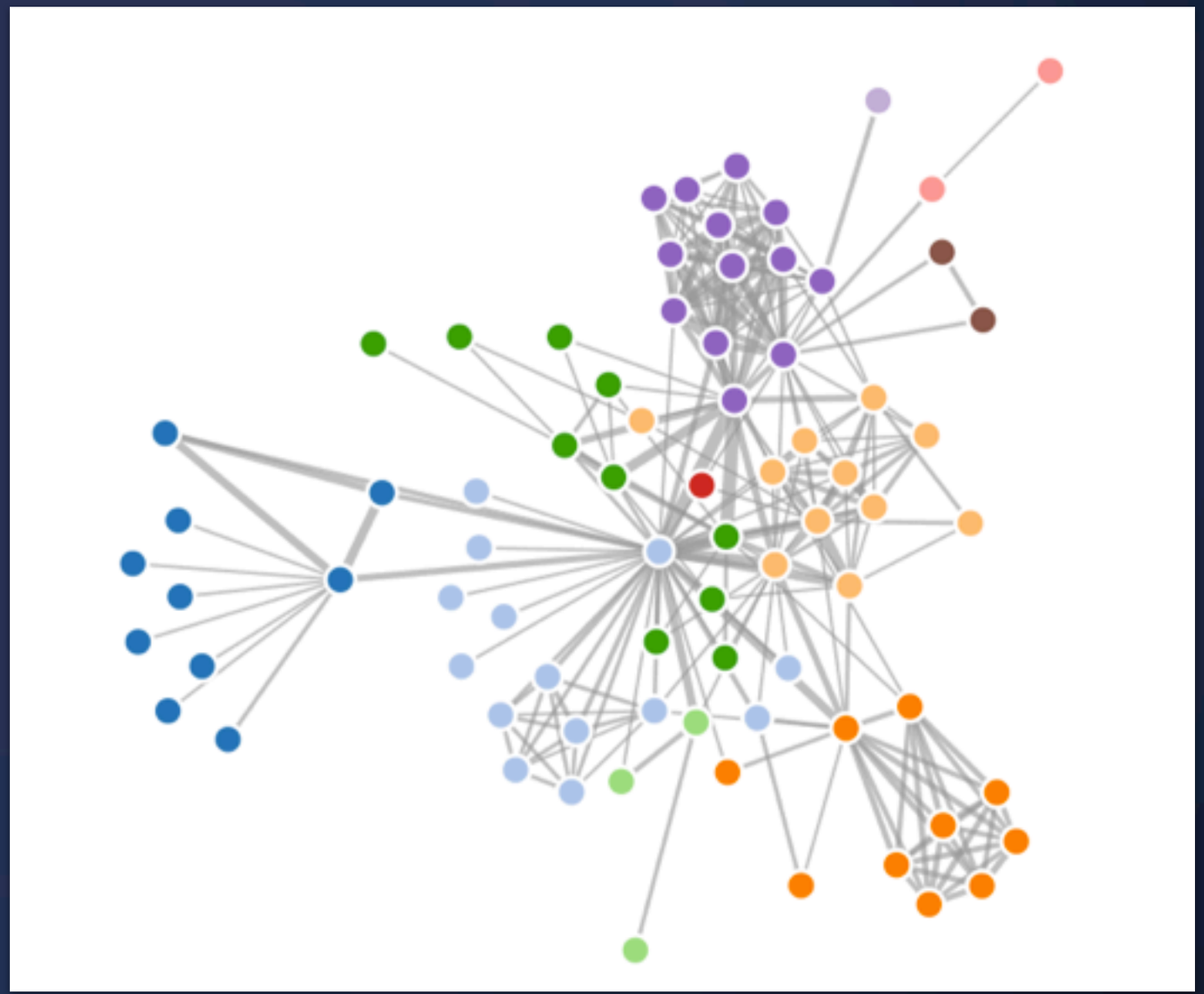
Circular



http://support.sas.com/documentation/cdl/en/grnvwug/61307/HTML/default/p0q343kxjyj36jn1e2z6lulkda3j.htm

Layout Heuristics

Force directed layout



http://mbostock.github.com/d3/ex/force.html

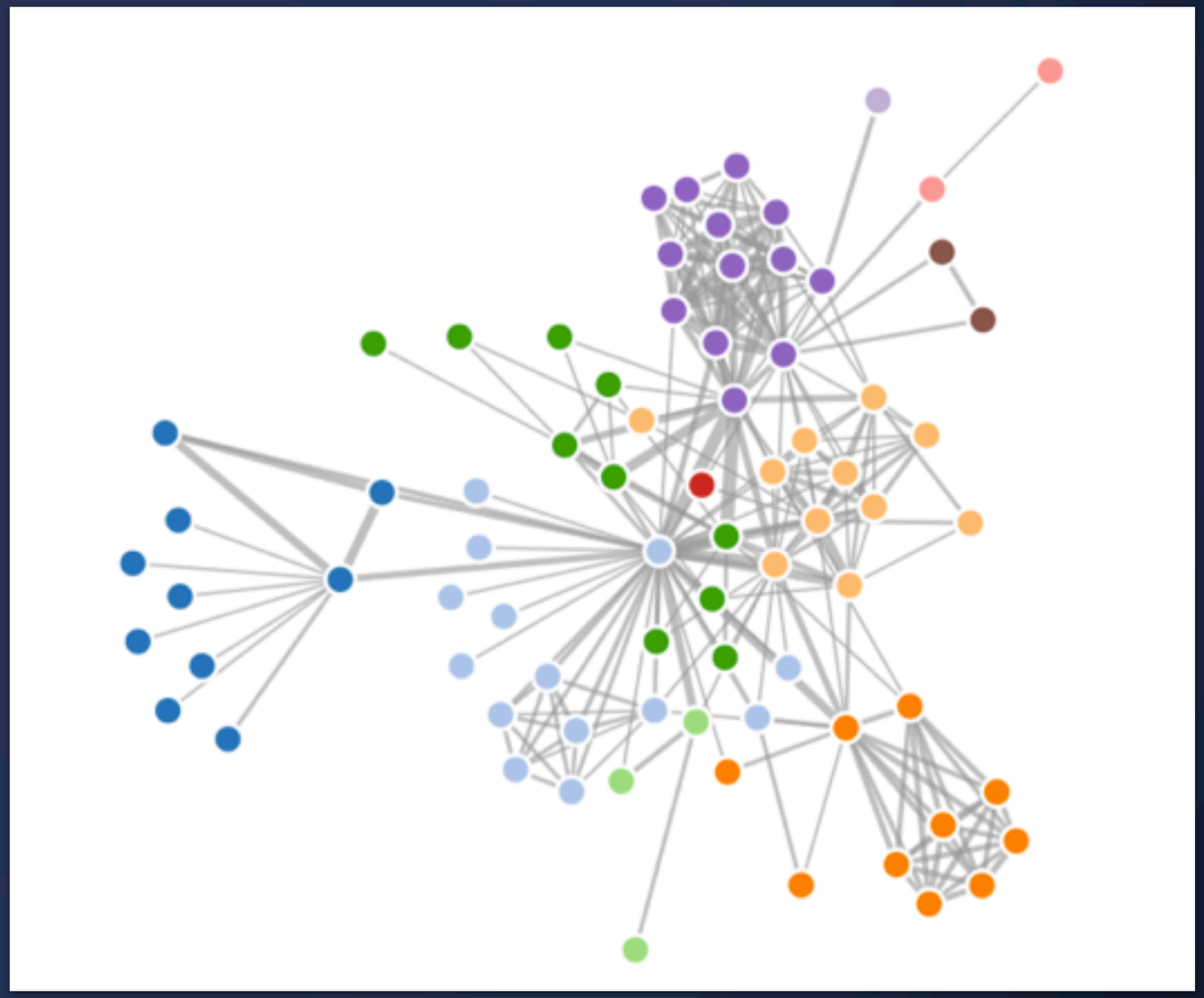
Layout Heuristics

Force directed layout

Treat edges like springs

Treat nodes like charged particles

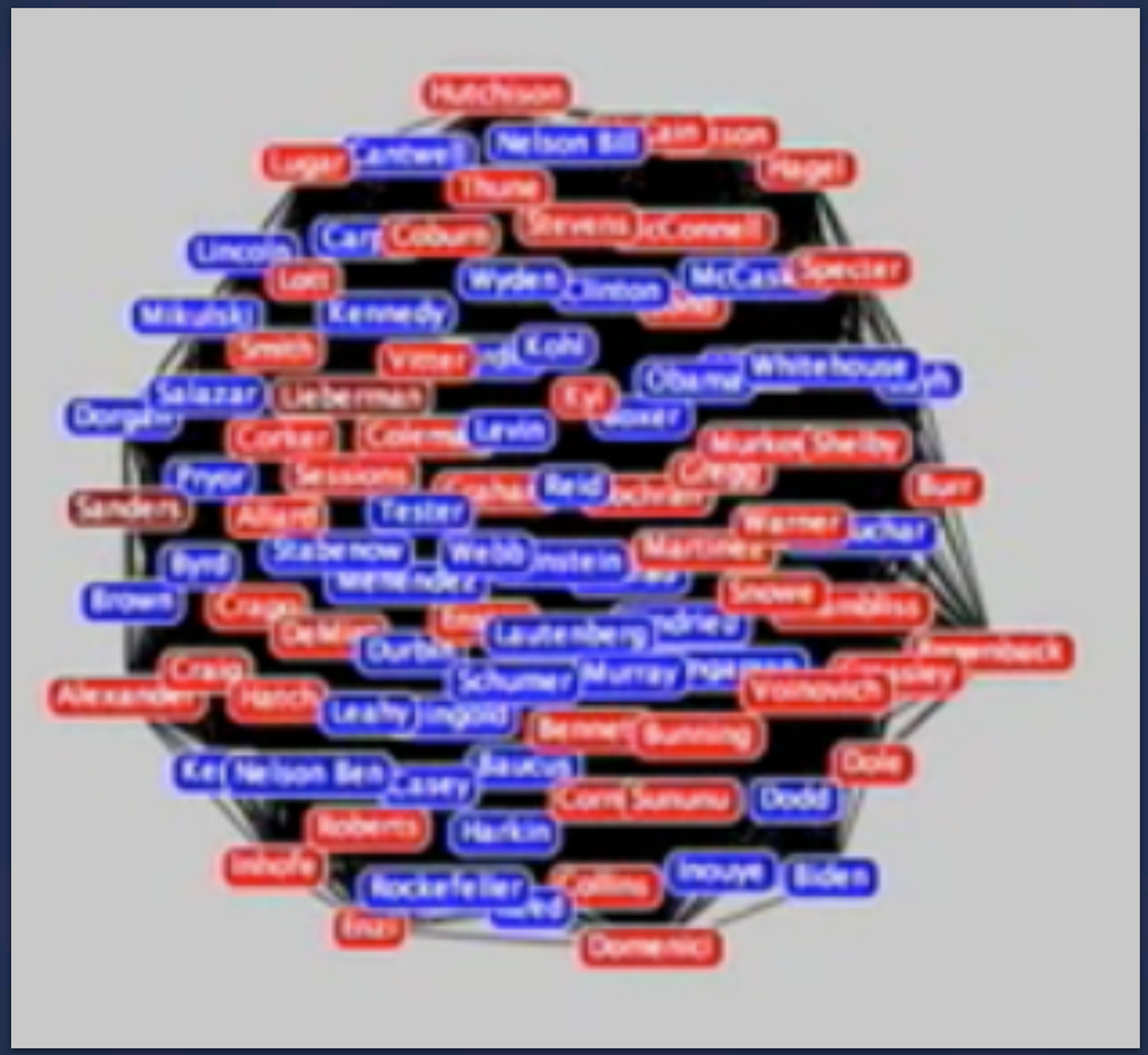
Repeatedly calculate in simulation



http://mbostock.github.com/d3/ex/force.html

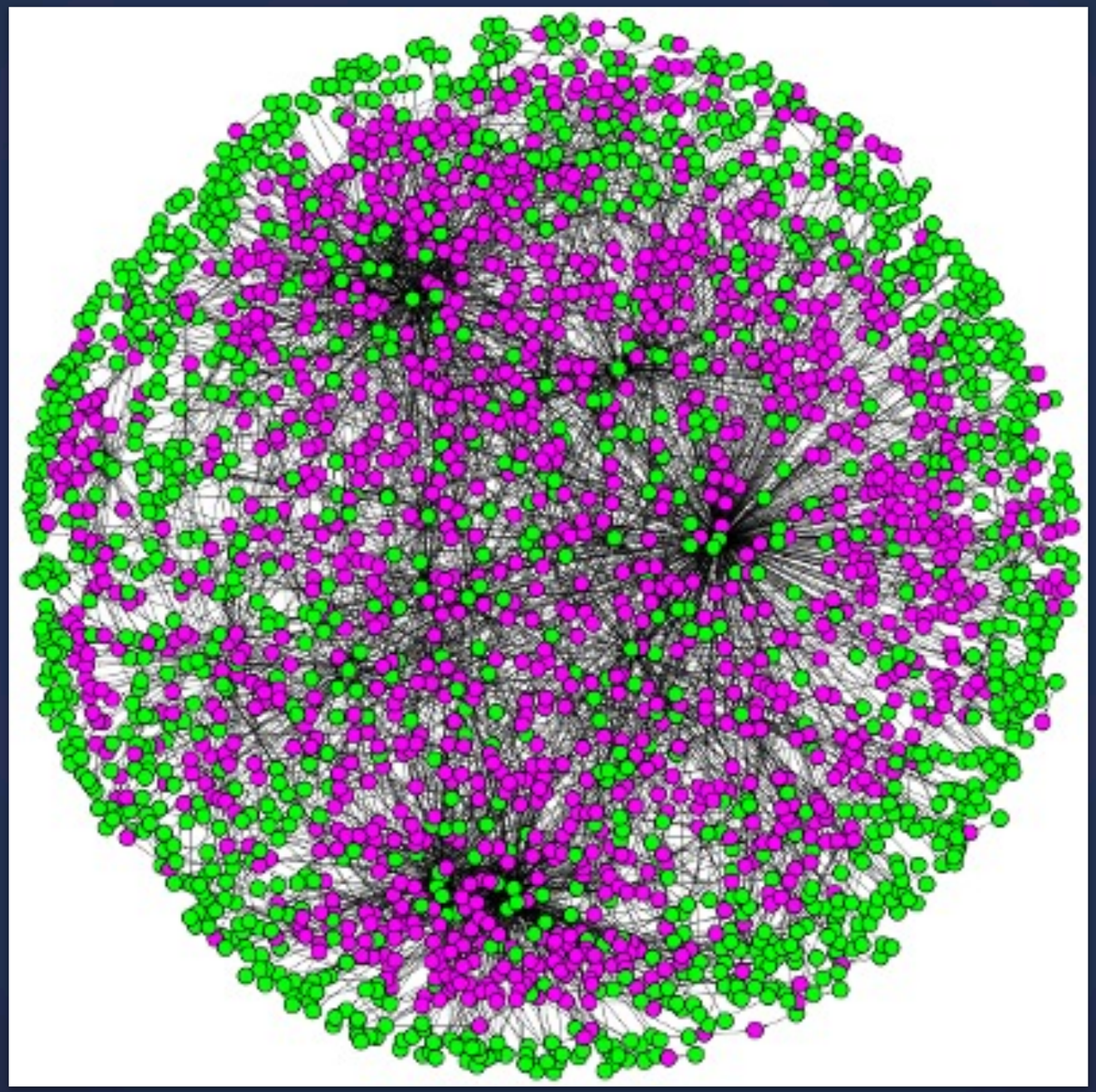
Force Directed Layout

Good example: SocialAction (Perer, Shneiderman, 2009)



http://vimeo.com/7308004

“Hairballs”

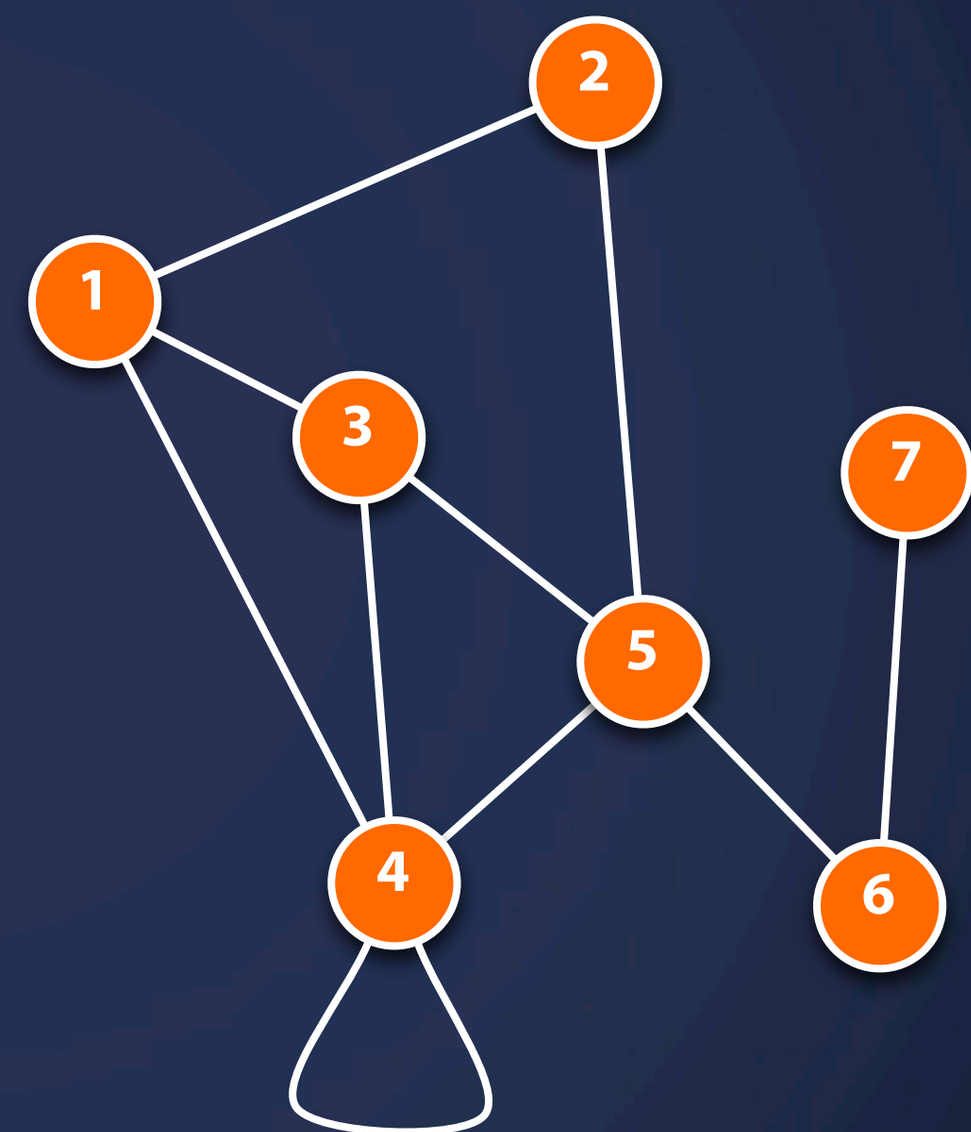


http://eagereyes.org/techniques/graphs-hairball

Adjacency Matrix

Alternative representation

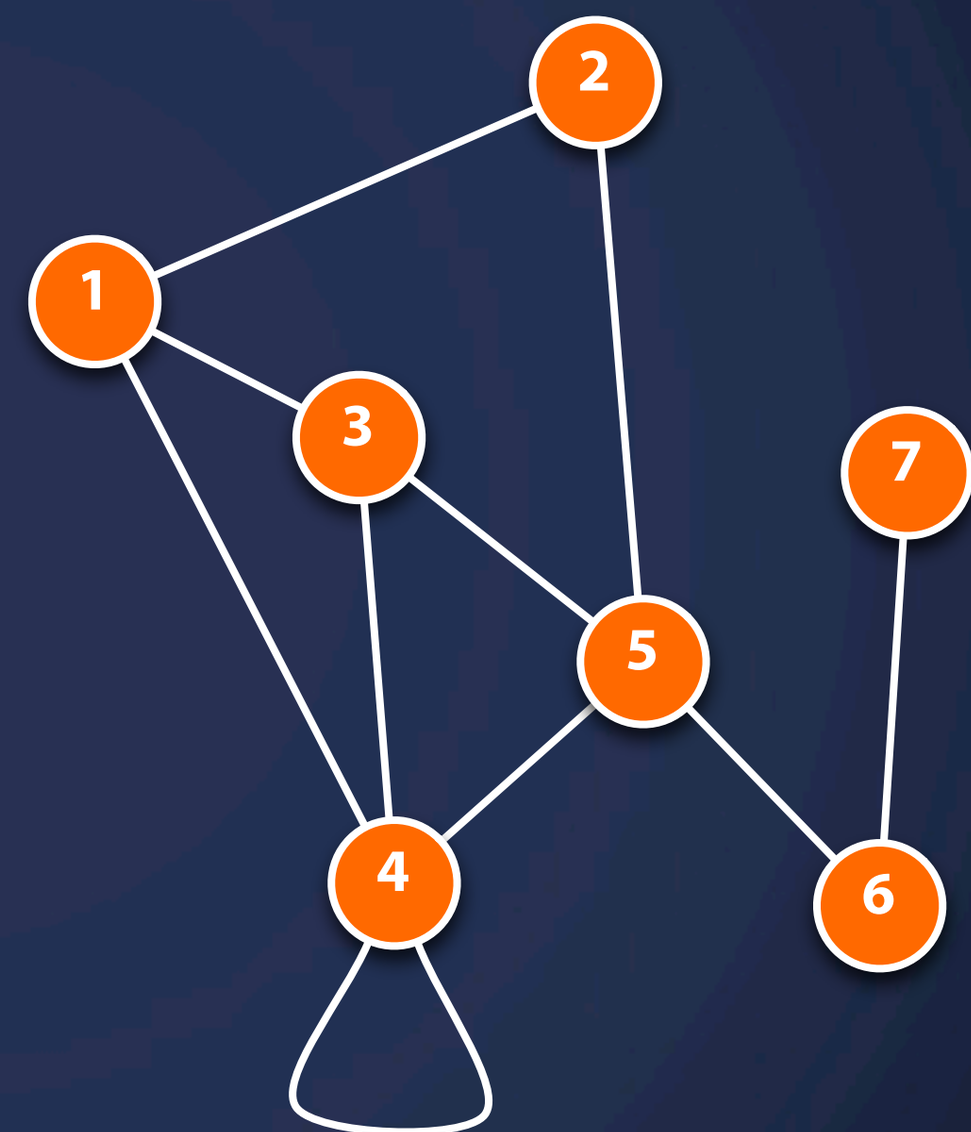
	1	2	3	4	5	6	7
1	0	1	1	1	0	0	0
2	1	0	0	0	1	0	0
3	1	0	0	1	1	0	0
4	1	0	1	1	1	0	0
5	0	1	1	1	0	1	0
6	0	0	0	0	1	0	1
7	0	0	0	0	0	1	0



Adjacency Matrix

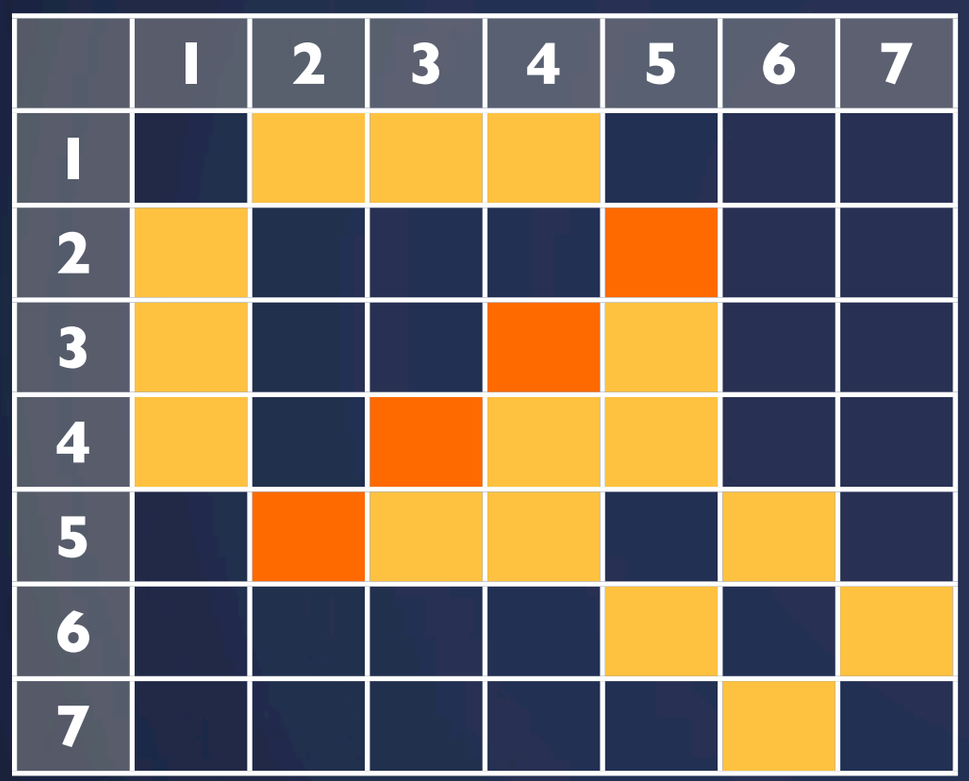
Alternative representation

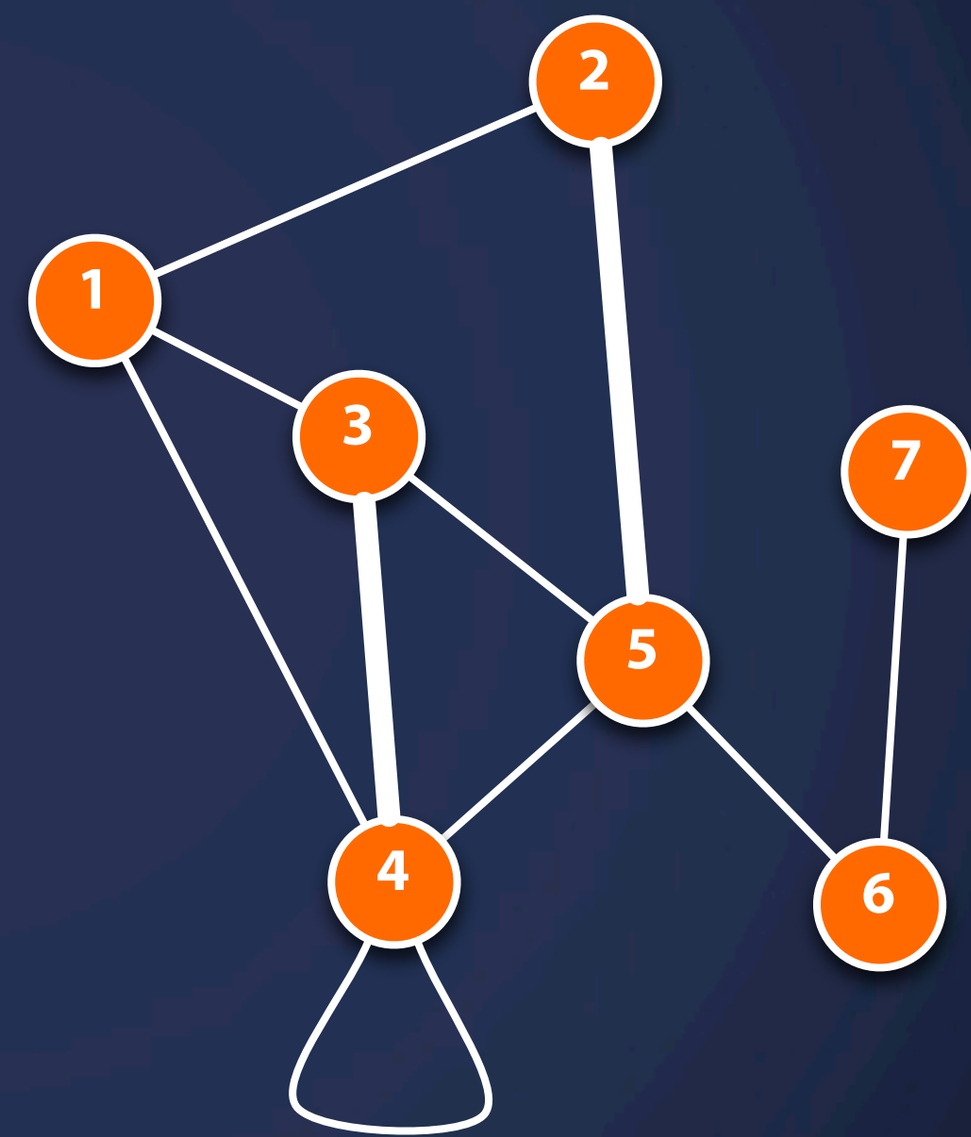
	1	2	3	4	5	6	7
1							
2							
3							
4							
5							
6							
7							



Adjacency Matrix

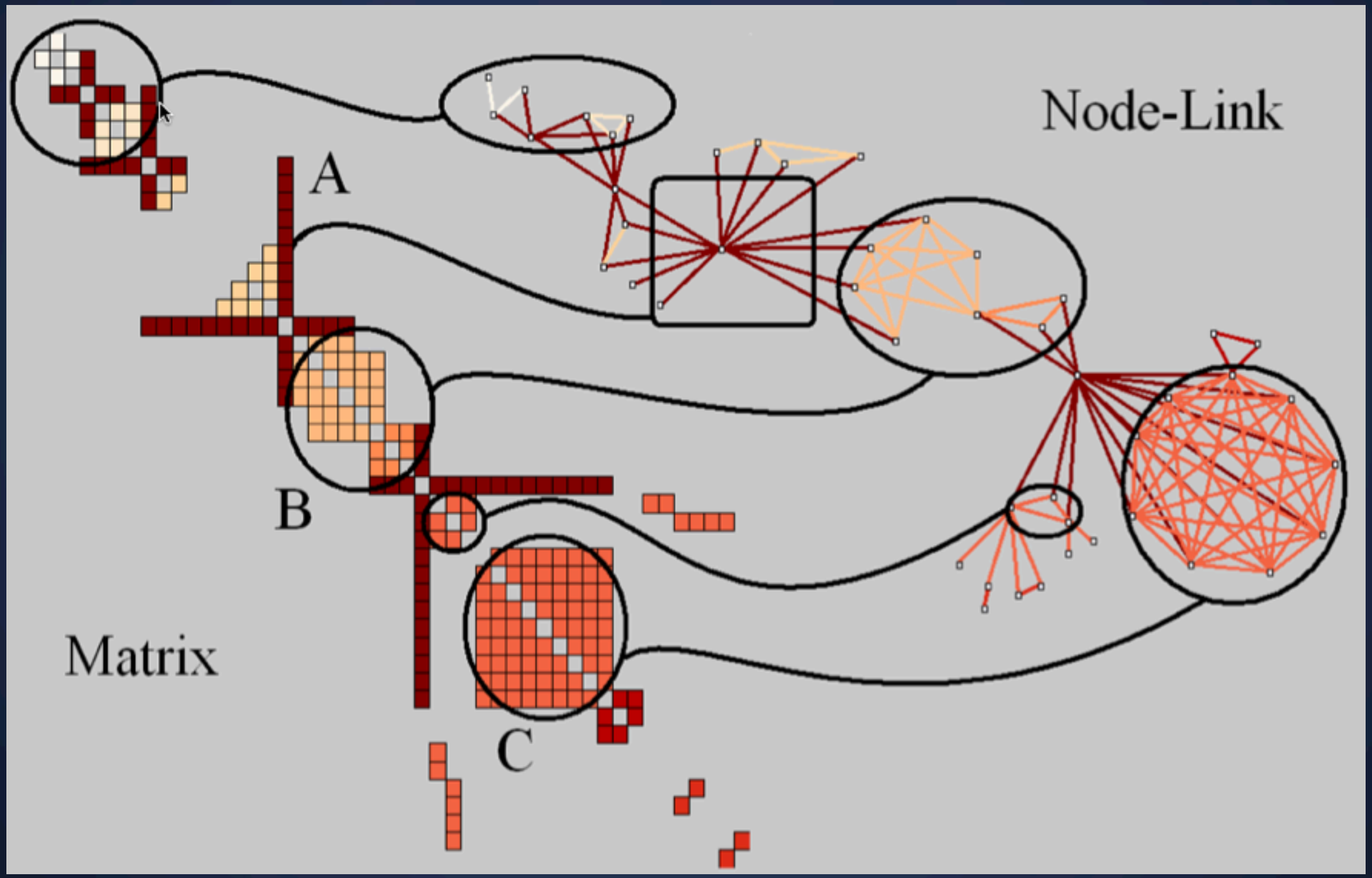
Alternative representation





Adjacency Matrix

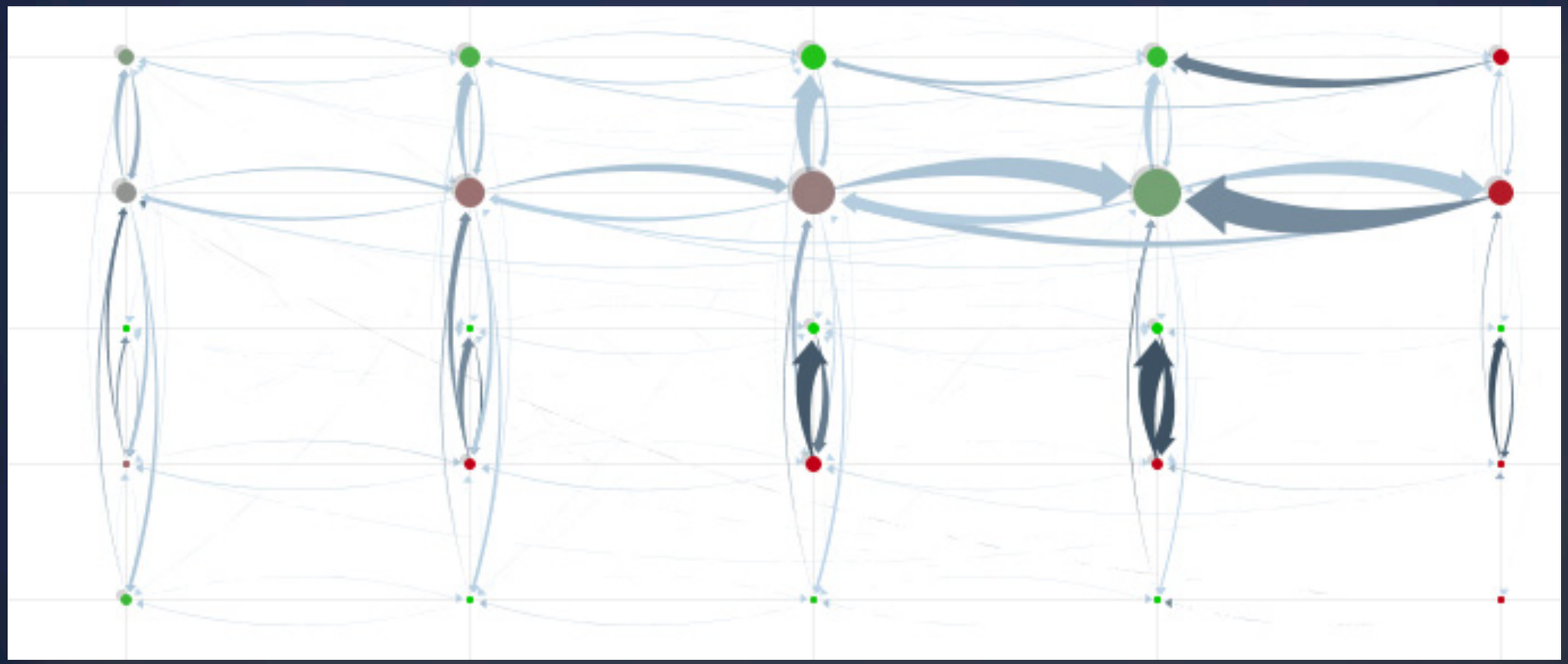
Alternative representation



http://www.lri.fr/~nhenry/docs/Henry-InfoVis2006.pdf

Pivot Graph

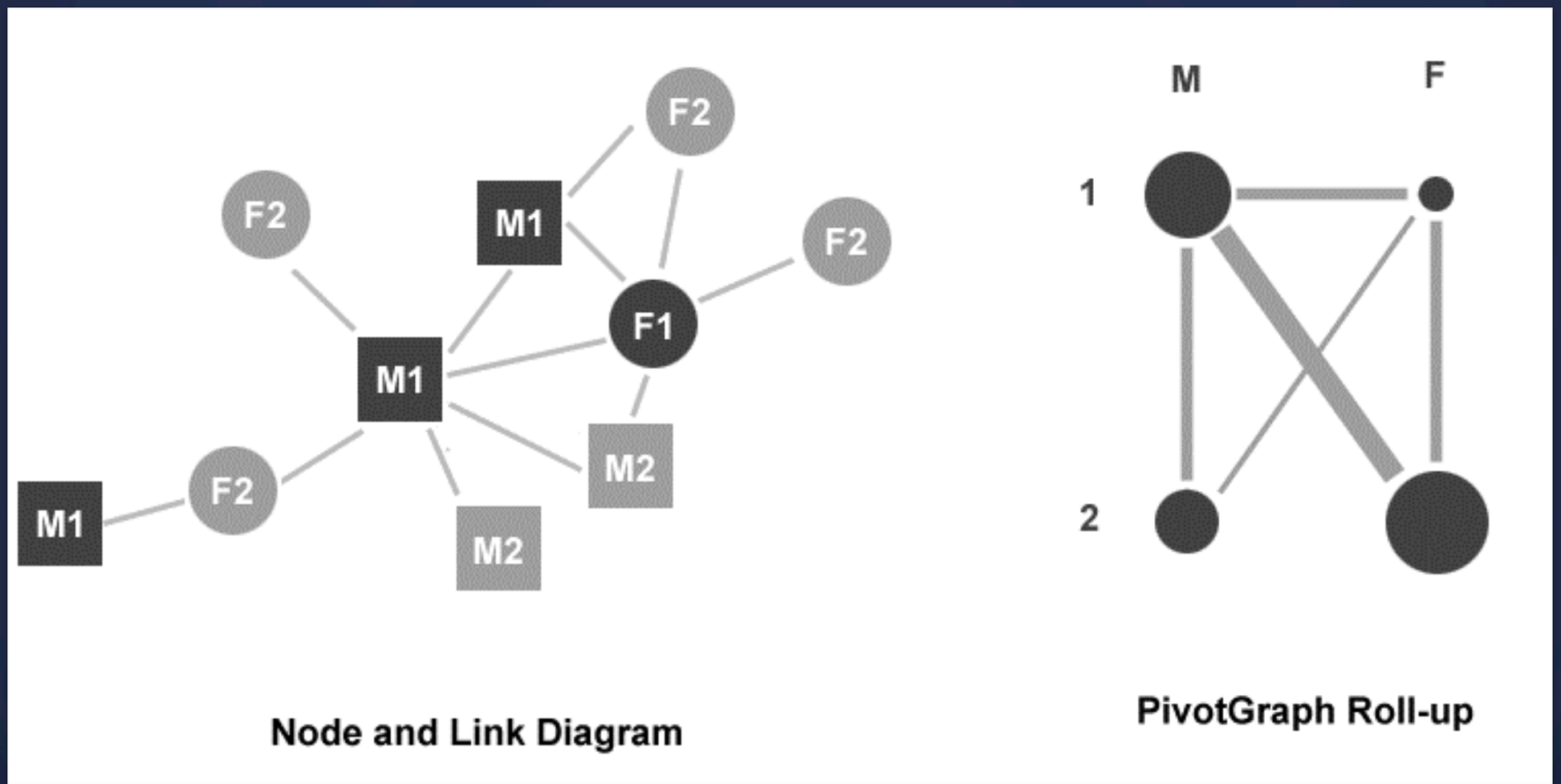
Dealing with large networks



Wattenberg, Visual Exploration of Multivariate Graphs

Pivot Graph

Dealing with large networks

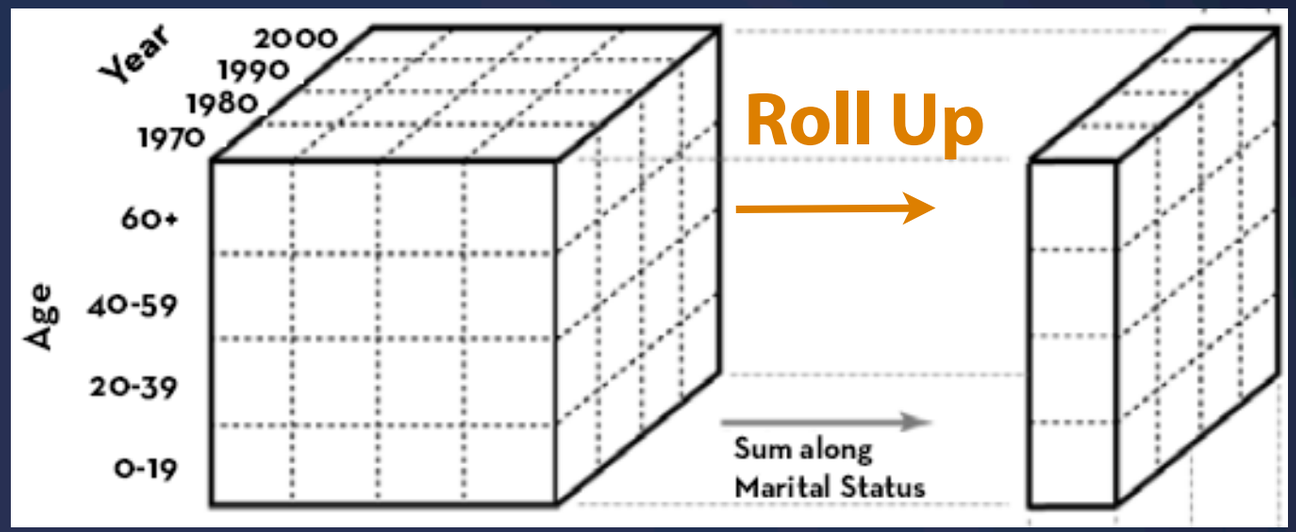


Wattenberg, Visual Exploration of Multivariate Graphs

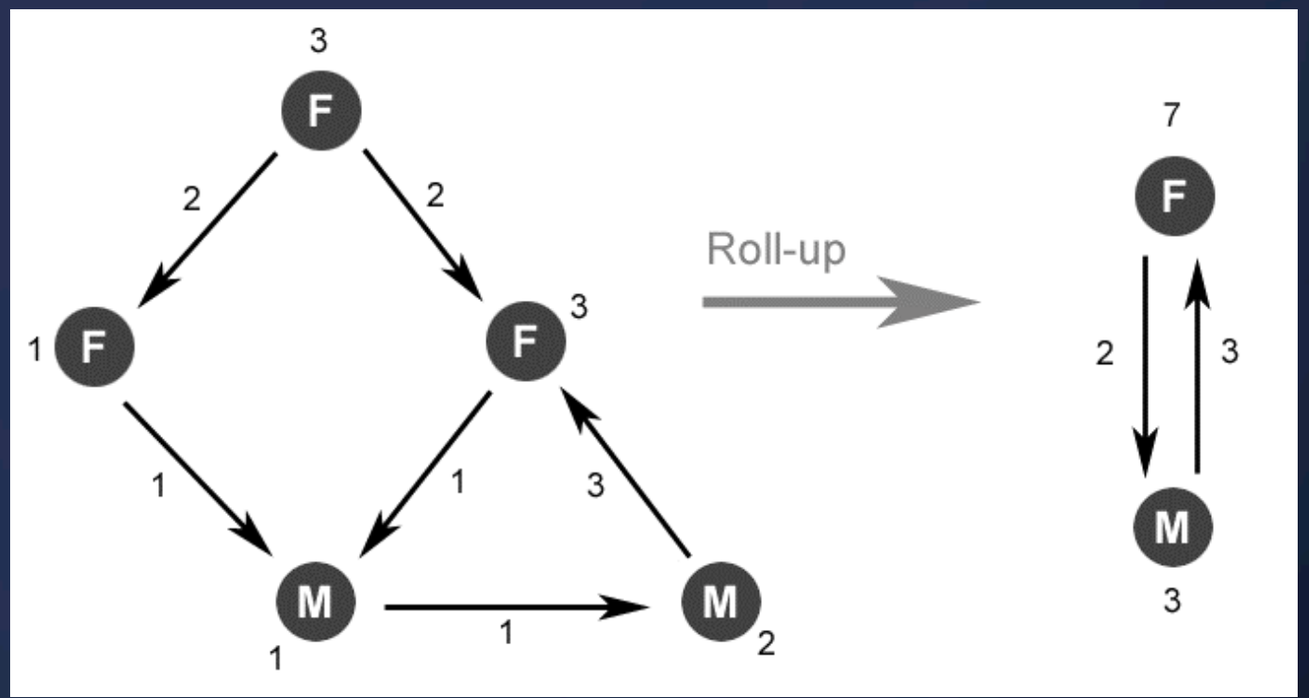
Pivot Graph

Dealing with large networks

Data Cube



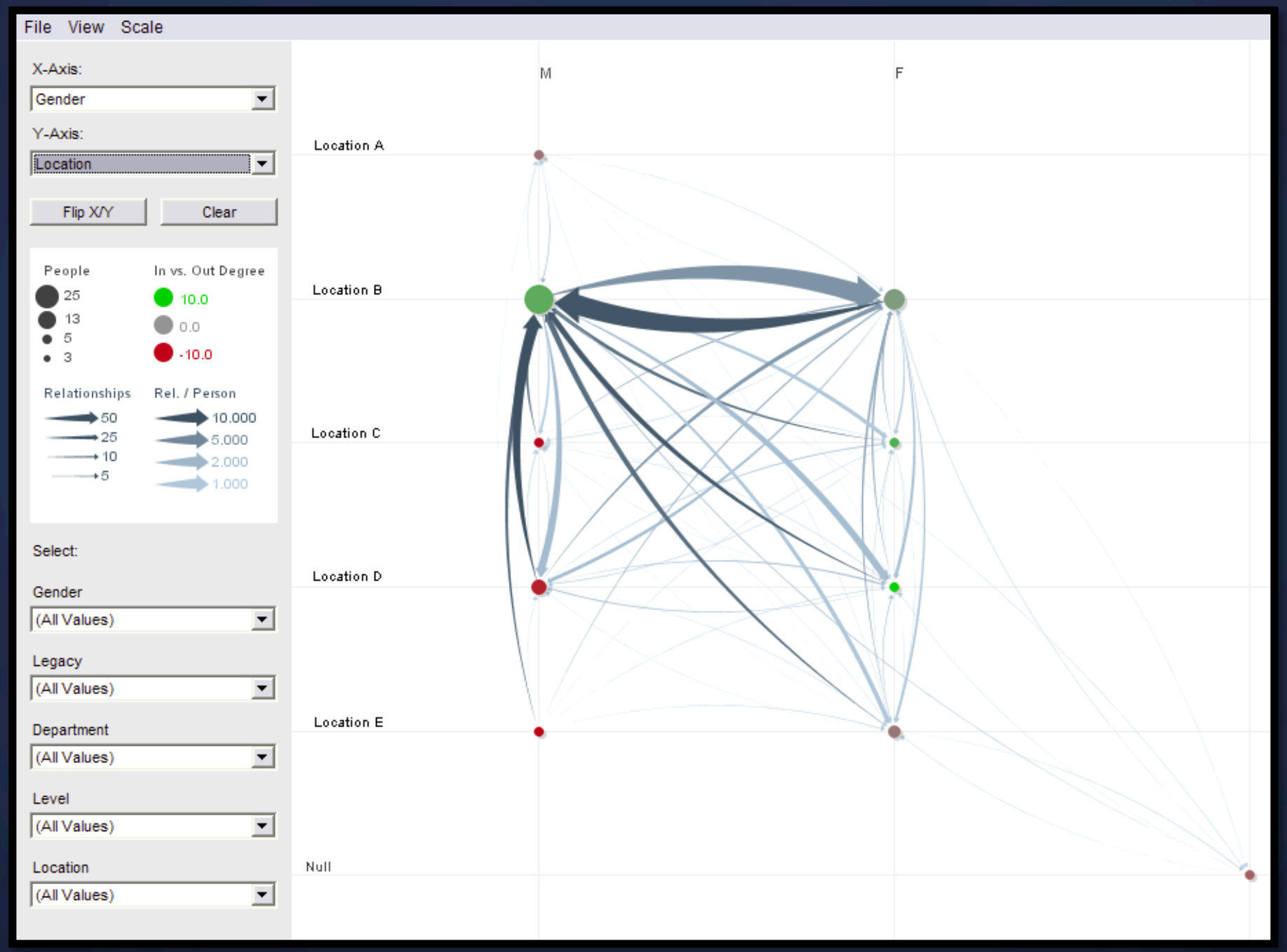
Network Graph



Wattenberg, Visual Exploration of Multivariate Graphs

Pivot Graph

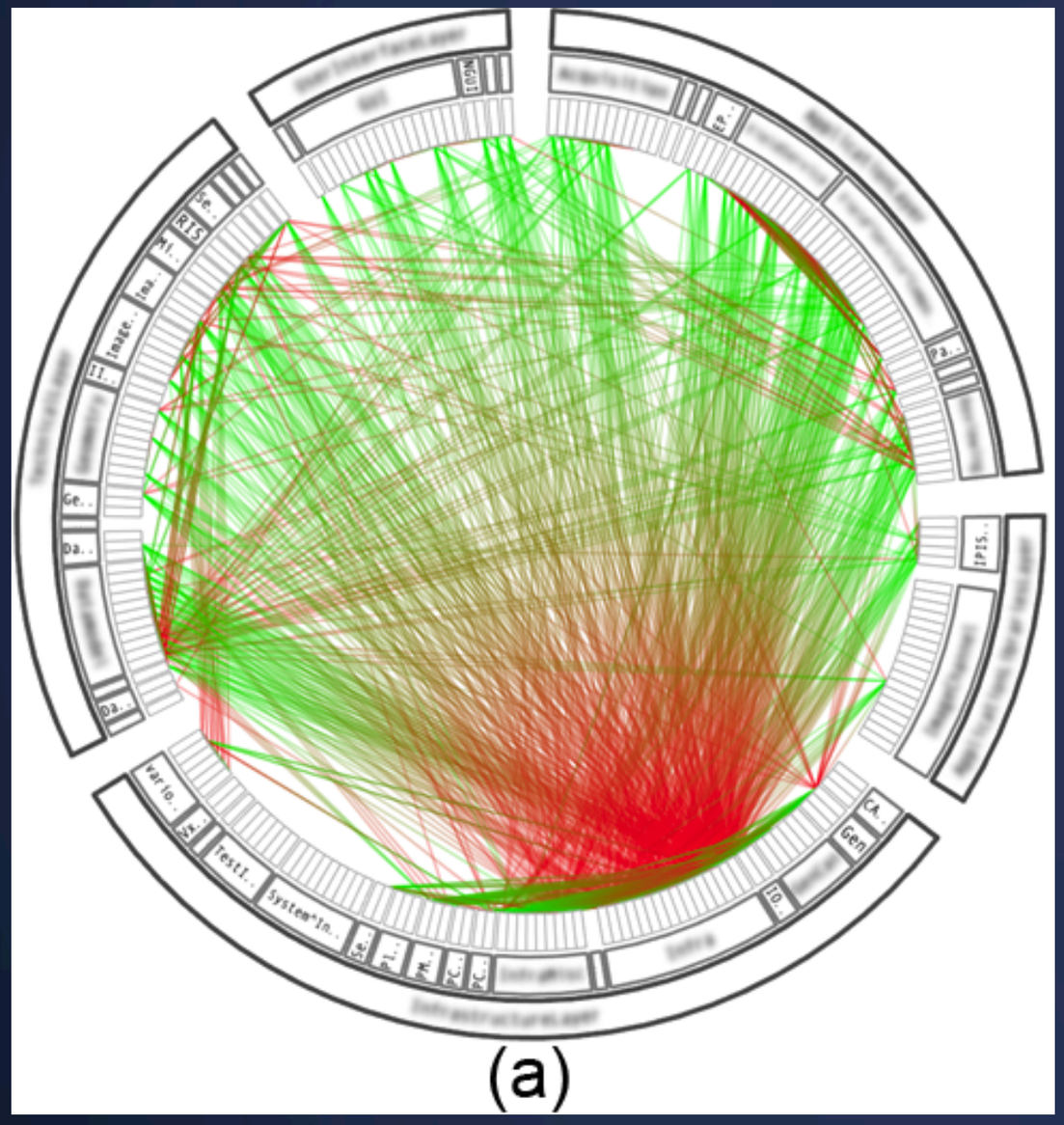
Dealing with large networks

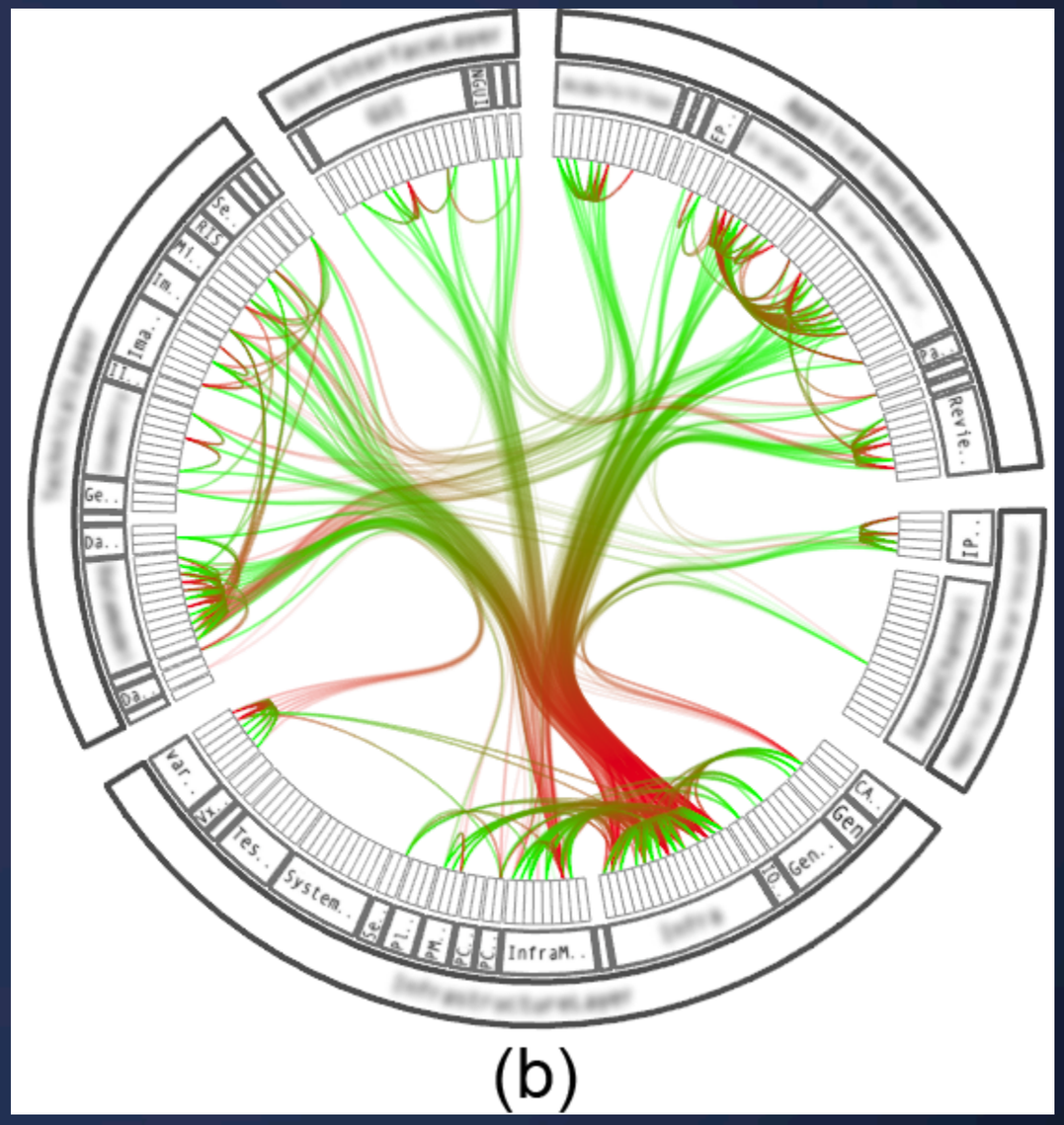


Wattenberg, Visual Exploration of Multivariate Graphs

Other ideas

Edge Bundling

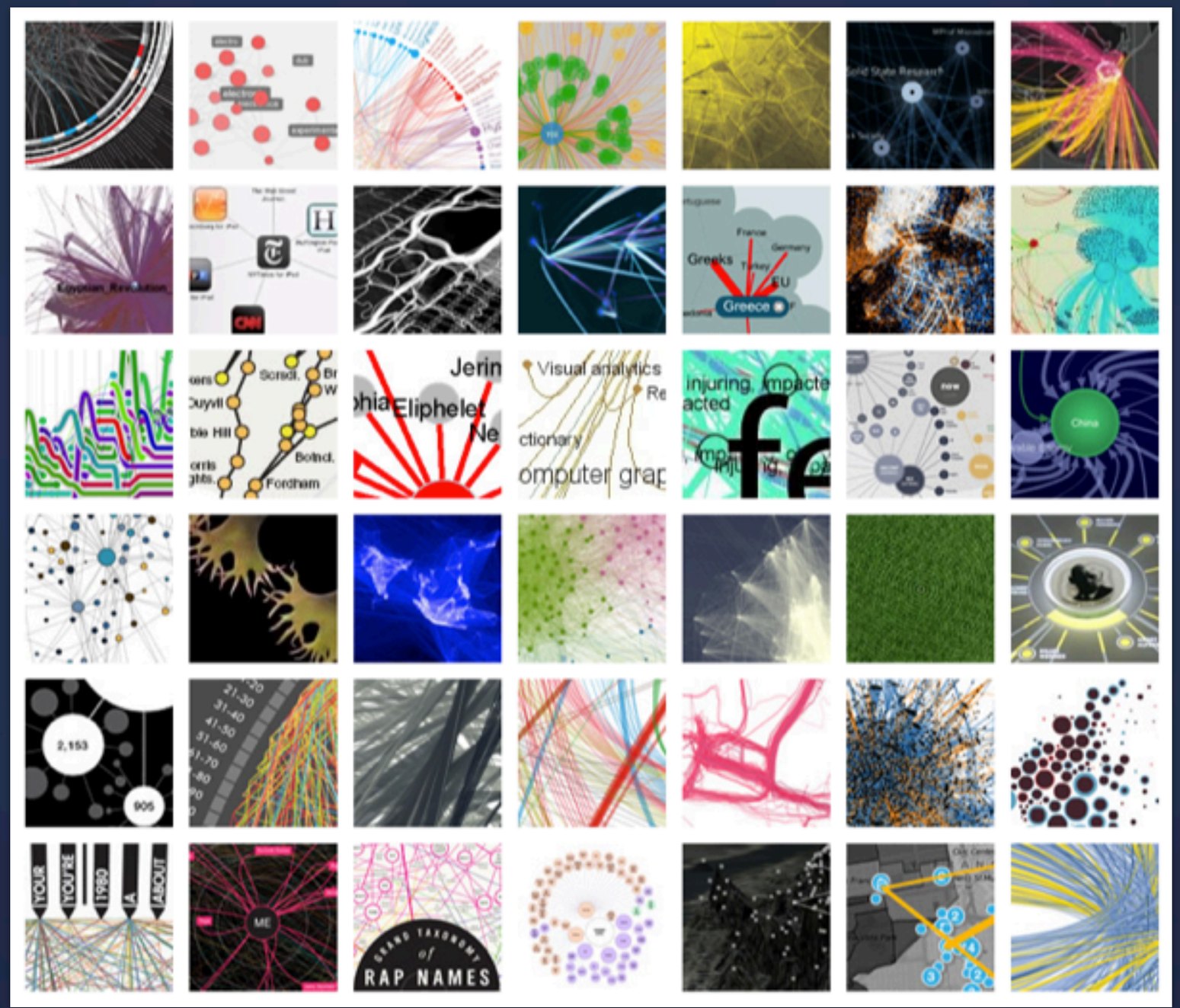




Holten, Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data

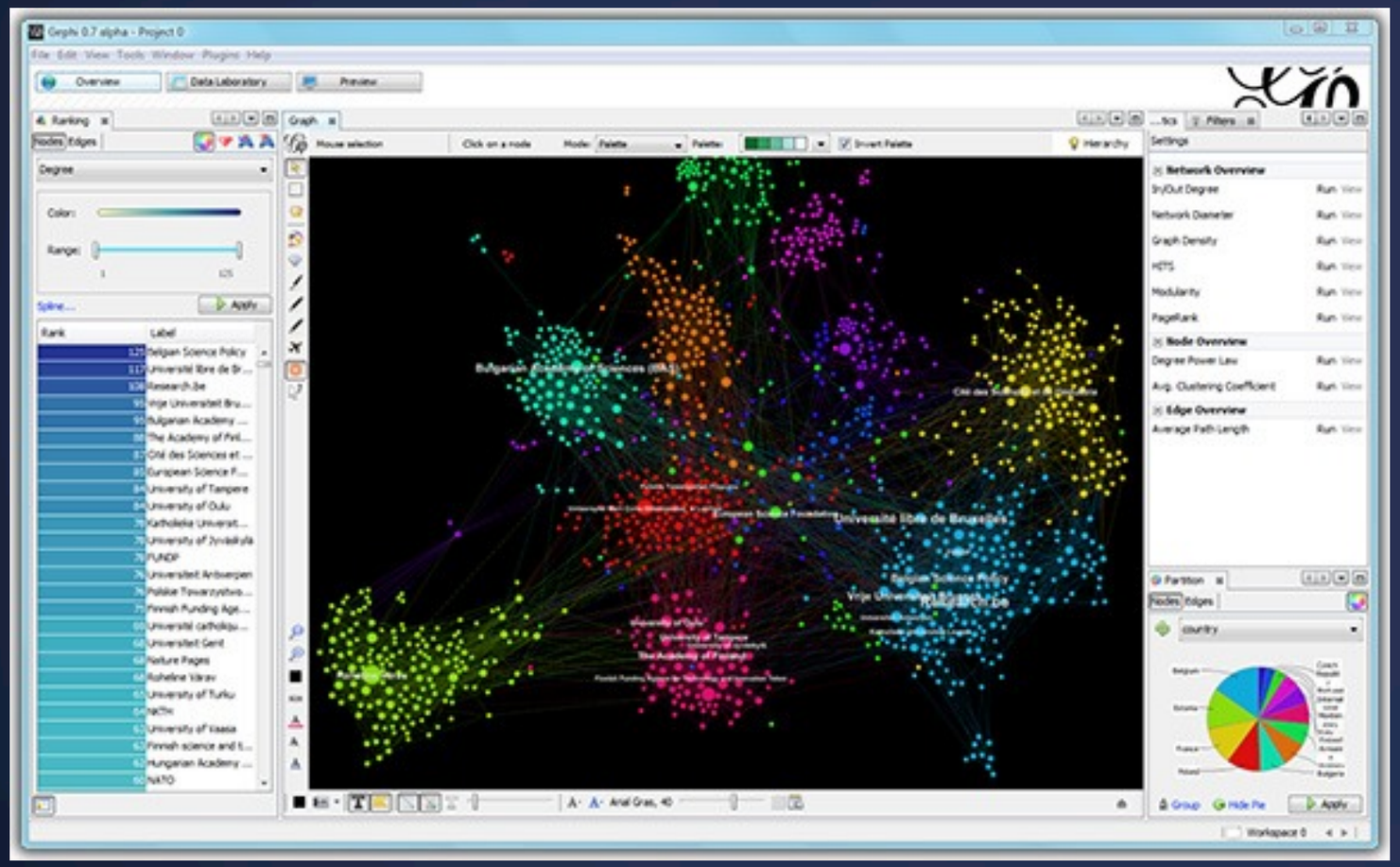
More Examples

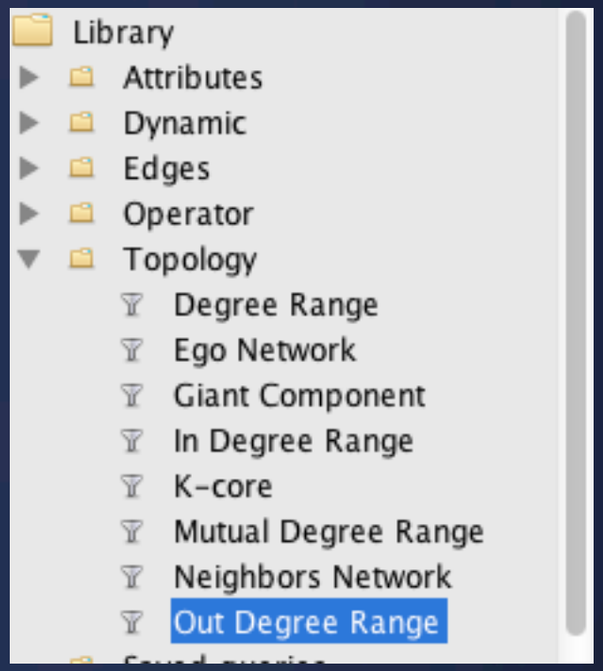
visualcomplexity.com



Tools

I.E. Gephi





http://gephi.org/

Recap

Show & Tell

1 2

Remaining Semester

Visualization Critique

Apr 17	Last lecture. Topic?
Apr 24	Design critique 2
May 6	Deadline for deliverables (11.59PM)
May 8	Project presentations

Labs

Gephi