Network visualisation

How to tame the complexity?

Paweł Widera
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BNC seminar

2014-02-04

Outline

1. Background and motivation
2. Network as a graph
3. Alternative visualisations
4. Hierarchical data
5. Summary

Motivation

How to analyse gene/protein interactions?

812.29	833.32	757.19	531.85	217.01	138.92	87.42

Experiment

- gene expression measured over time
- correlation between expression profiles
- discover regulation mechanism

Example network

- **SeedNet**
  gene interactions in dormant and germinating Arabidopsis seeds

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How to analyse gene/protein interactions?

812.29	833.32	757.19	531.85	217.01	138.92	87.42

$$\rho = 0.96511$$

250.23	281.13	192.31	112.94	54.94	45.02	34.19

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AT1G01190	AT1G01340	0.89293
AT1G01310	AT1G01460	0.91384
AT1G01460	AT1G01500	0.94066
AT1G01170	AT1G01540	0.89946
AT1G01170	AT1G01620	0.96471
AT1G01450	AT1G01760	0.89595
AT1G01540	AT1G01800	0.88155
AT1G01310	AT1G01980	0.90427
AT1G01460	AT1G01980	0.92478
AT1G01980	AT1G02000	0.95345
AT1G01280	AT1G02050	0.9715
AT1G01970	AT1G02150	0.88201
AT1G01100	AT1G02160	0.90574
AT1G01610	AT1G02190	0.96254
AT1G01510	AT1G02280	0.89949
AT1G01540	AT1G02560	0.90601
AT1G01500	AT1G02660	0.89368
AT1G01920	AT1G02690	0.8818
AT1G01280	AT1G02813	0.96732
AT1G02370	AT1G02870	0.93776
AT1G01170	AT1G03040	0.94222

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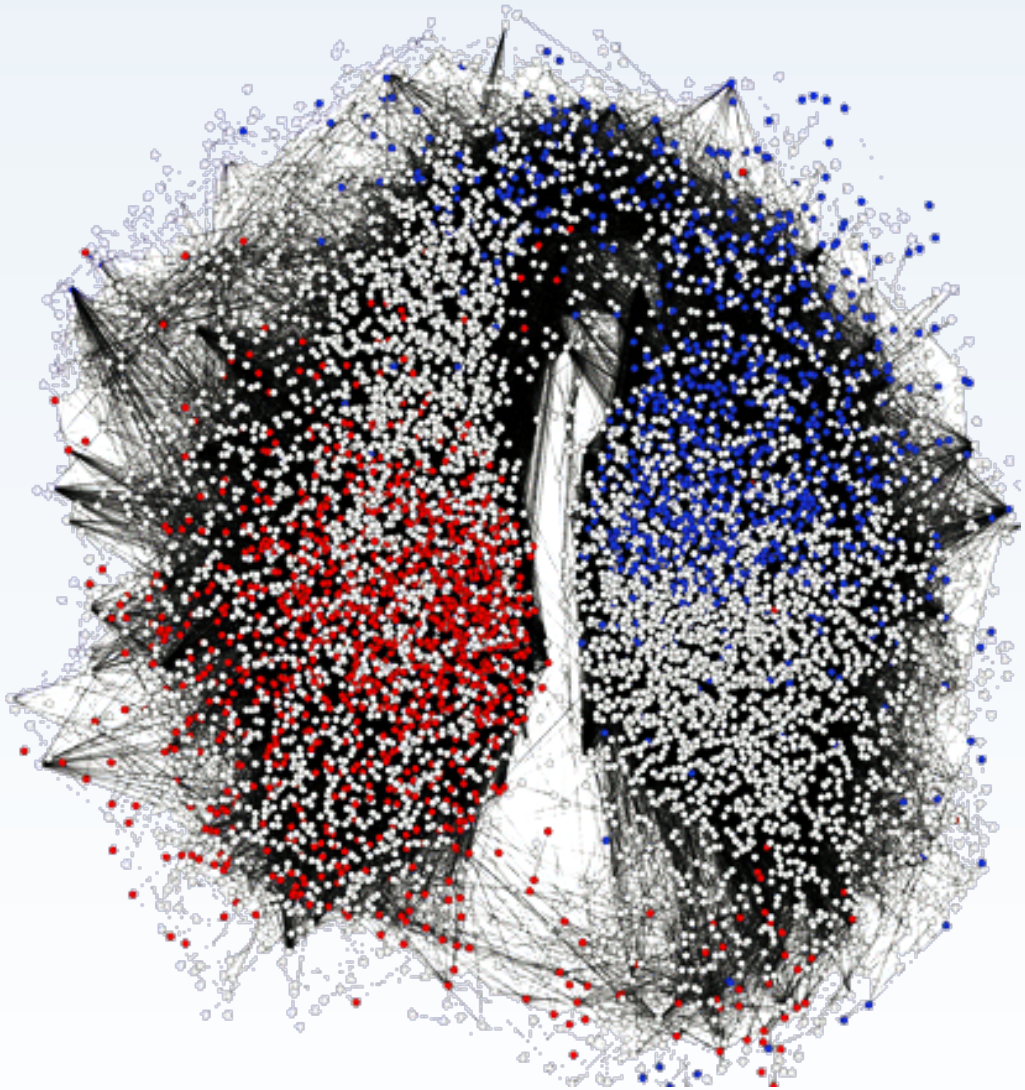

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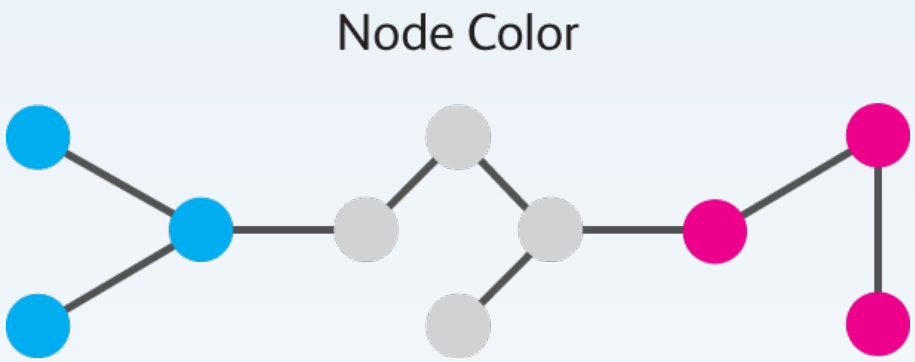
http://vseed.nottingham.ac.uk/

Network visual attributes



Visual elements

- nodes
- edges

Real-world example

- **SCoPNet**
  predicted gene interactions in dormant and germinating Arabidopsis seeds

http://blog.visual.ly/network-visualizations/

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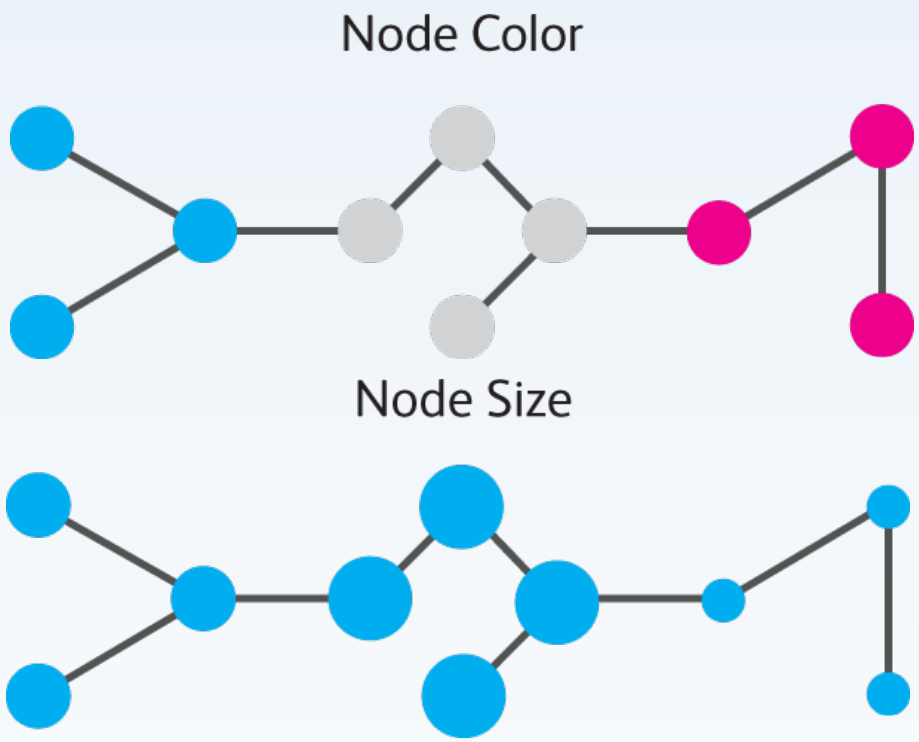

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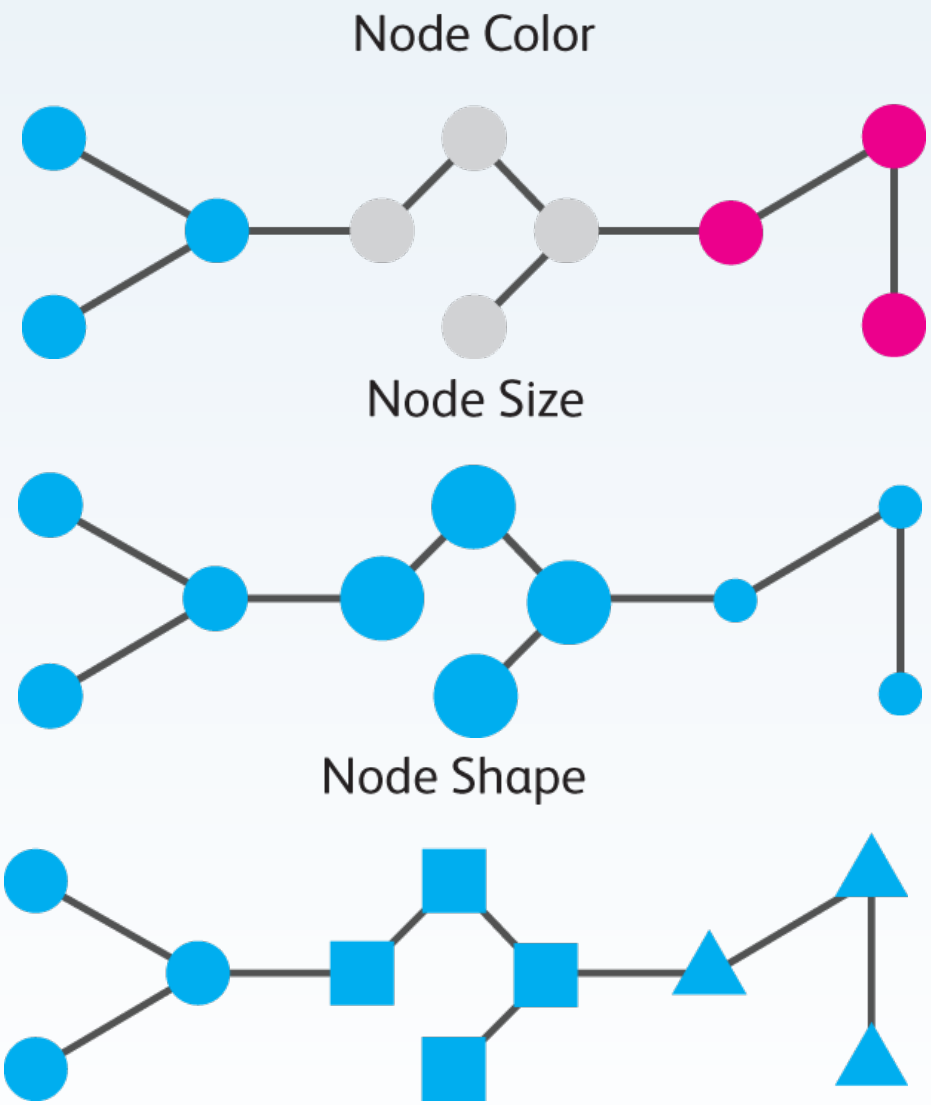

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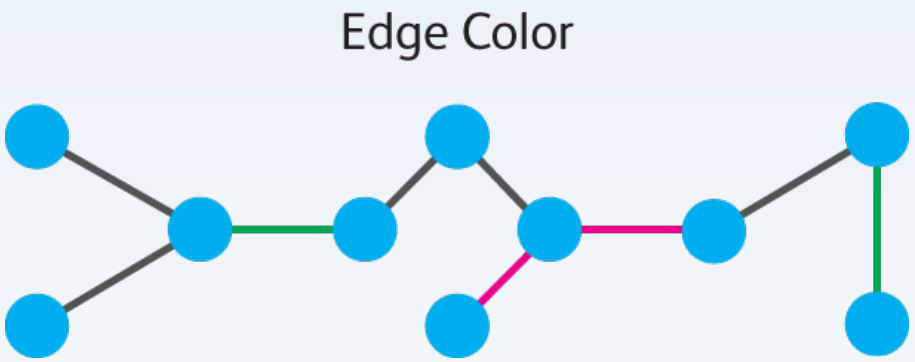

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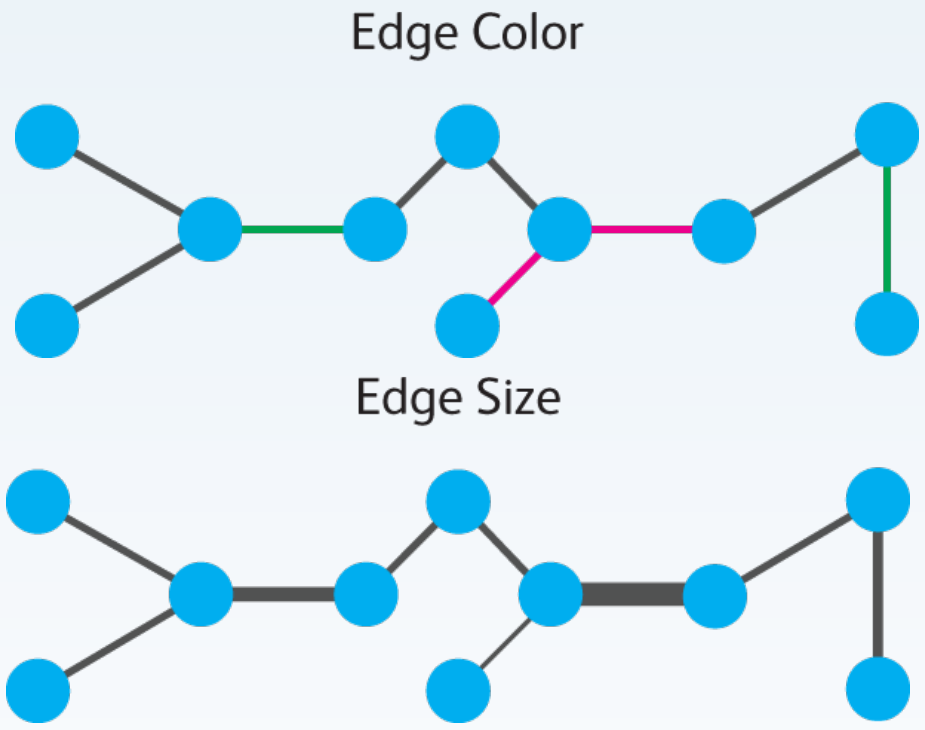

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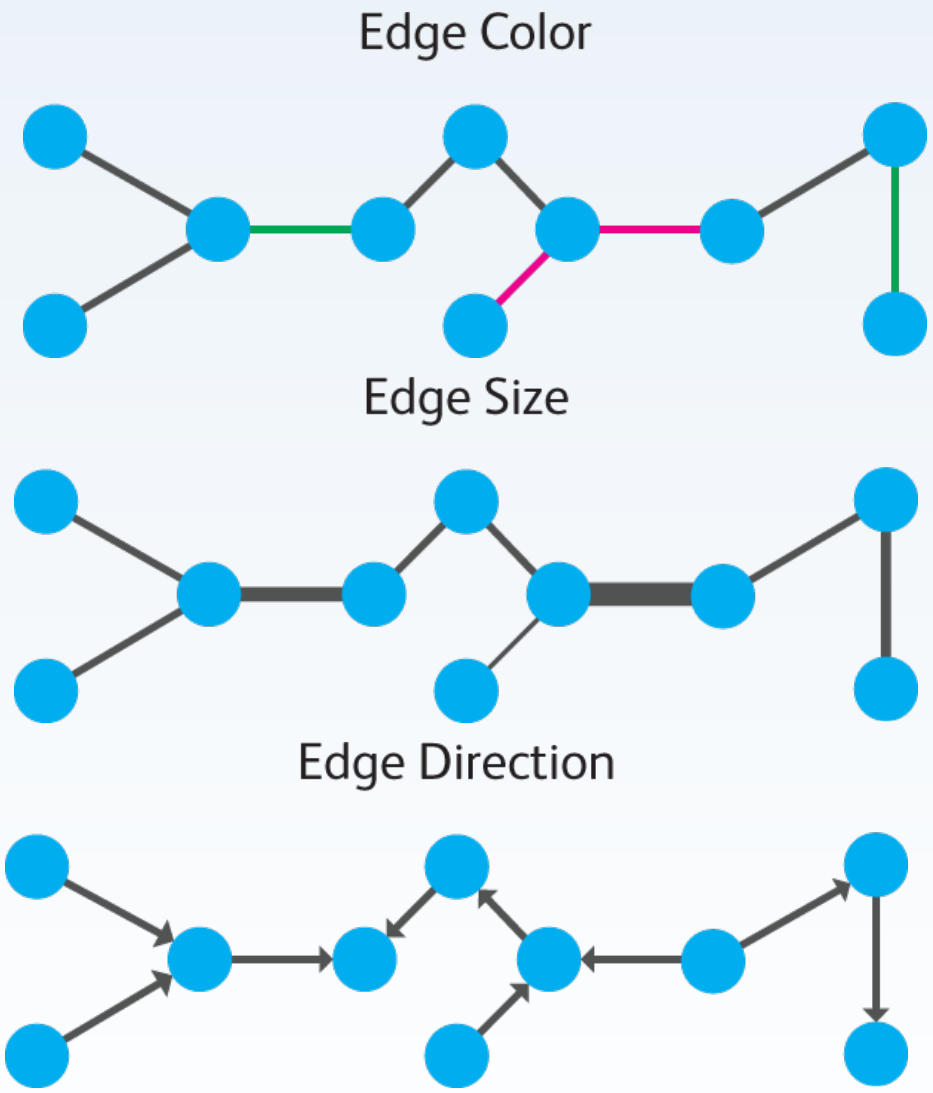

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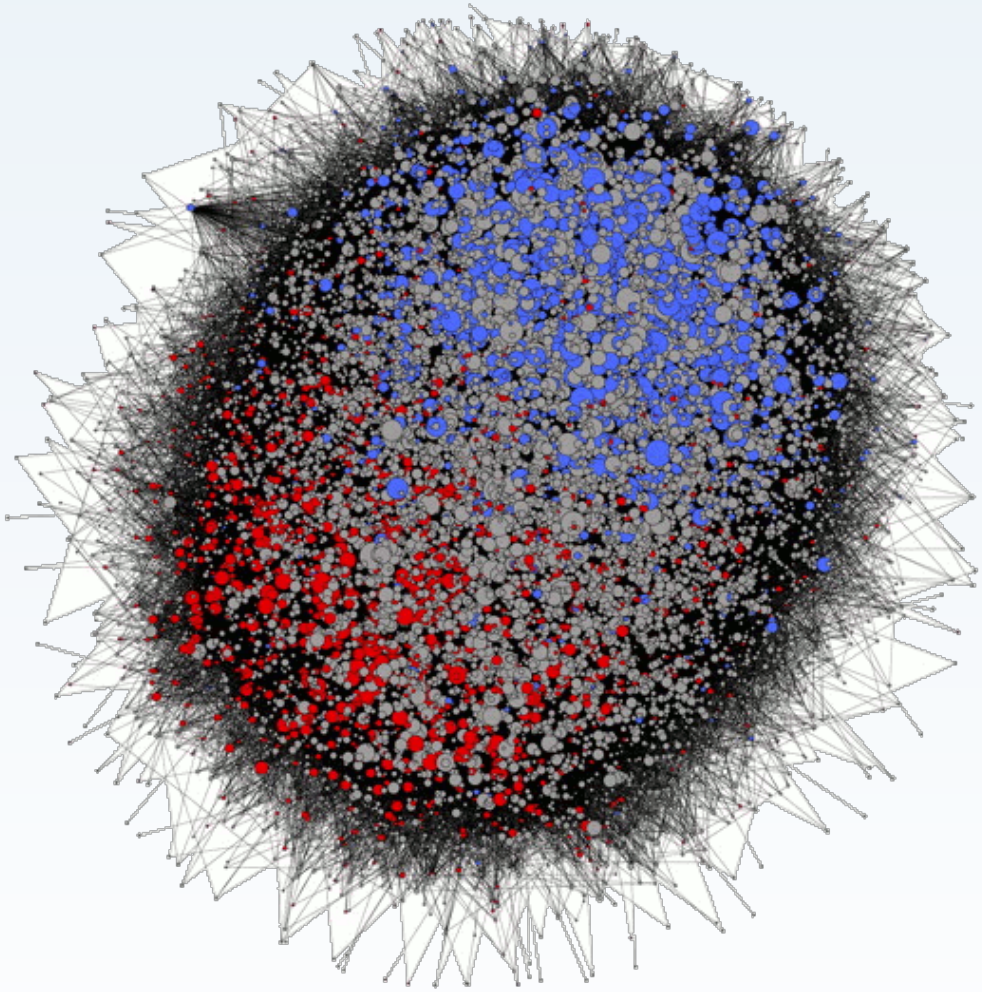

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Real-world example

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Manual positioning

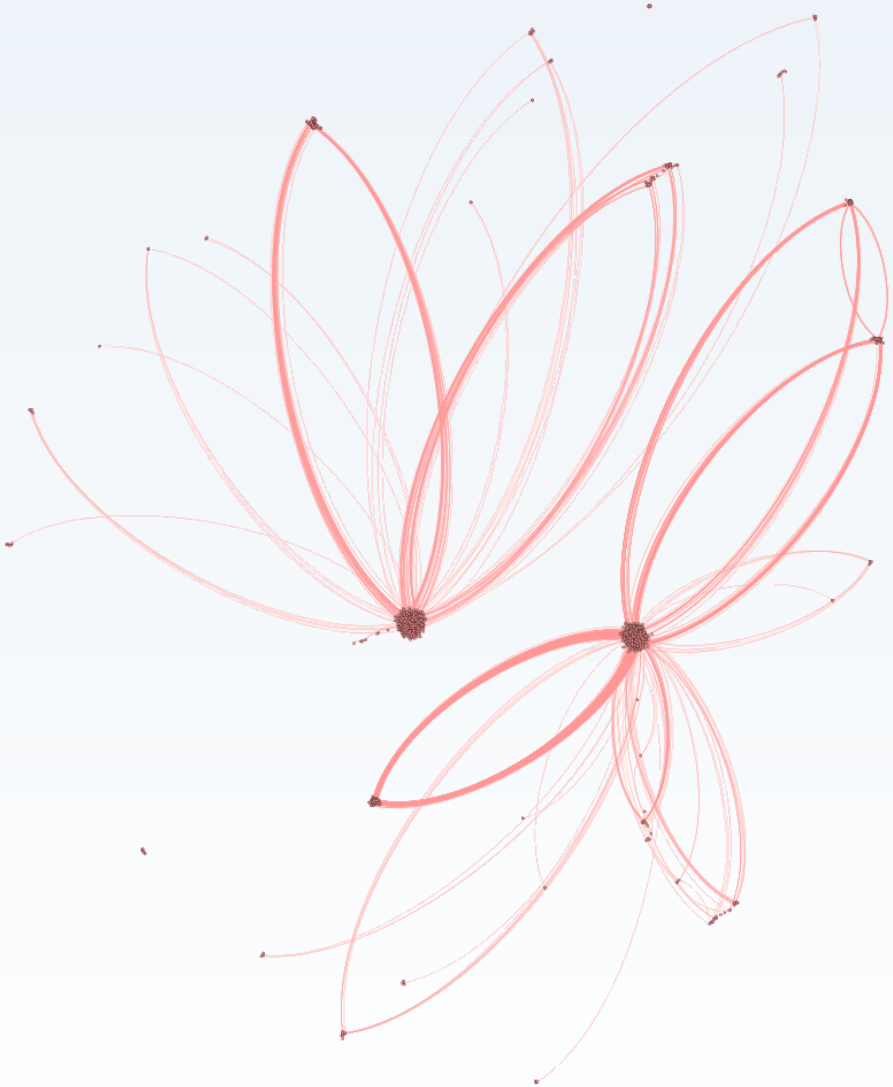
How to make a network infographic?

Name	Spirit	Mixer	Liqueur	Cordial
Abbey Cocktail	Gin (2 oz)	Orange Juice (1.5 oz)		
Orange Blossom	Gin (.75 oz); Sweet Vermouth (.75 oz)	Orange Juice (.75 oz)		
Adirondack	Gin (2 oz);	Orange Juice (2 oz)		
Adonis	Dry Sherry (1 oz); Sweet Vermouth (.5 oz); Dry Vermouth (.5 oz)			
Brandy Alexander	Brandy (1 oz)	Cream (1 oz)	Crème de Cacao (1 oz)	
Algonquin	Rye Whiskey (1.5 oz); Dry Vermouth (.75 oz)	Pineapple Juice (.75 oz)		
Allies Cocktail	(London) Dry Gin (1.5 oz); (French) Dry Vermouth (1.5 oz)		Russian Kummel (2 dashes)	
Americano	Sweet Vermouth (1 oz)	Club Soda (dash)	Campari (1 oz)	
Angel's Tit		Half and Half (.25 oz)	White Crème de Cacao (.25 oz); Maraschino Liqueur (.25 oz)	
Aviation	Gin (2 oz)	Lemon Juice (.5 oz)	Maraschino Liqueur (.25 oz); Crème de Violette (dash)	
B&B	Brandy (1 oz)		Benedictine (1 oz)	
Bacardi	Bacardi Light Rum (1.75 oz)	Lime Juice (.75 oz)		Grenadine (.25 oz)
Bamboo	Dry Vermouth (1.5 oz); Sherry (1.5 oz)			
Biltmore	Gin (2 oz); Sweet Vermouth (1 oz)		Maraschino Liqueur (dash)	
Bishop	Rum (3 oz); Red Wine (1 oz)	Lime juice (1 oz)		Simple Syrup (1 tsp)
Black Stripe	Dark Rum (2 oz)	Hot Water (1 oz)		
Black Velvet	Champagne (4 oz); Stout (4 oz)			
Blood and Sand	Scotch Whiskey (.75 oz); Cherry Brandy (.75 oz); Sweet Vermouth (.75 oz)	Orange Juice (.75 oz)		
Bloody Mary	Vodka (1.5 oz)	Tomato Juice (3 oz); Lemon Juice (.5 oz)		
Blue Blazer	Scotch Whiskey (2 oz)	Boiling Water (1.5 oz)		
Bolo	Rum (2 oz)	Lime Juice (.5 oz); Orange Juice (1 oz)		
Brandy	Brandy (2 oz)		Orange Curacao (.5 oz)	
Brandy Daisy	Brandy (2 oz); Rum (2 dashes)	Lime Juice (1 tsp); club soda (dash)	Curacao (3 dashes)	Simple Syrup (3 dashes)
Brandy Milk Punch	Brandy (2 oz)	Milk (4 oz)		Simple Syrup (1 oz)
Brandy Old-Fashioned	Brandy (3 oz)	Water (dash)		

"Coctails" infographic by Pop Chart Lab

Layout algorithms

In what situations they work well?



FruitNet (unpublished) — OpenOrd layout

Special cases

- feature emphasis
- natural order
  e.g. time, flow
- small size

Layout algorithms

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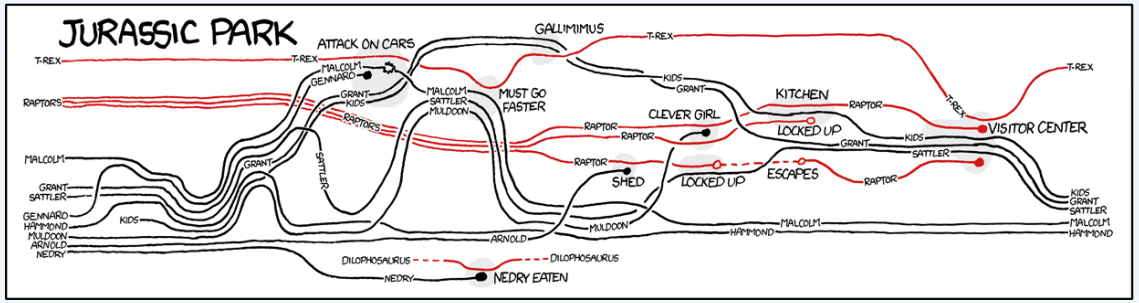

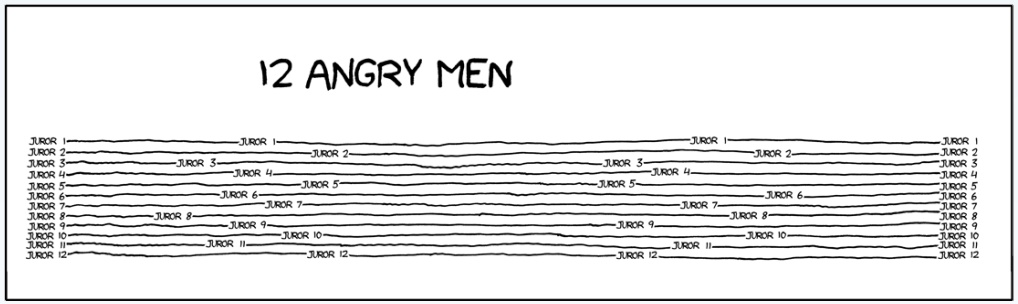

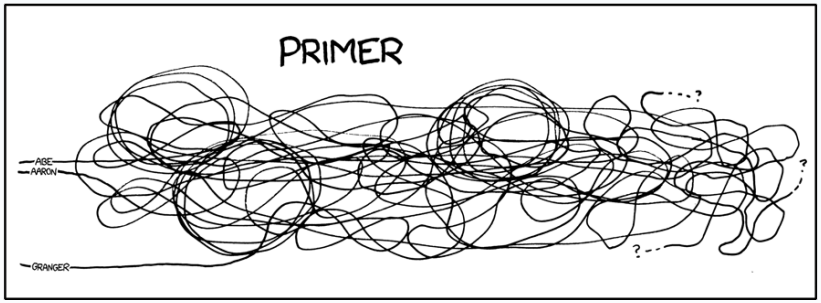

http://xkcd.com/657/

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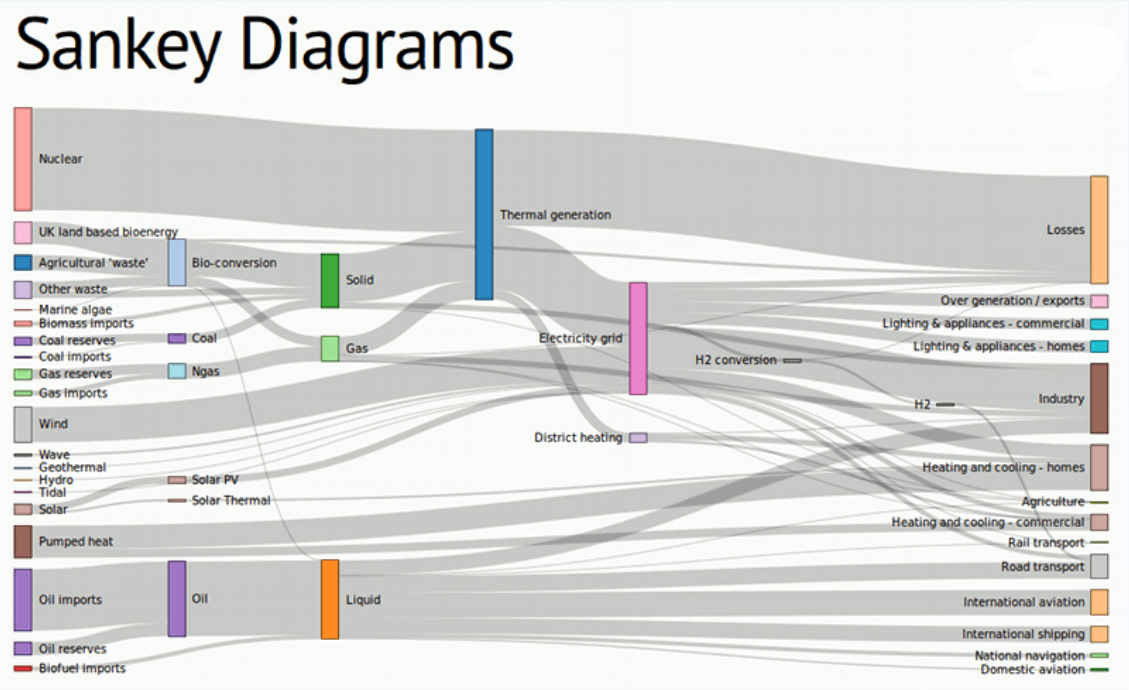

http://bost.ocks.org/mike/sankey/

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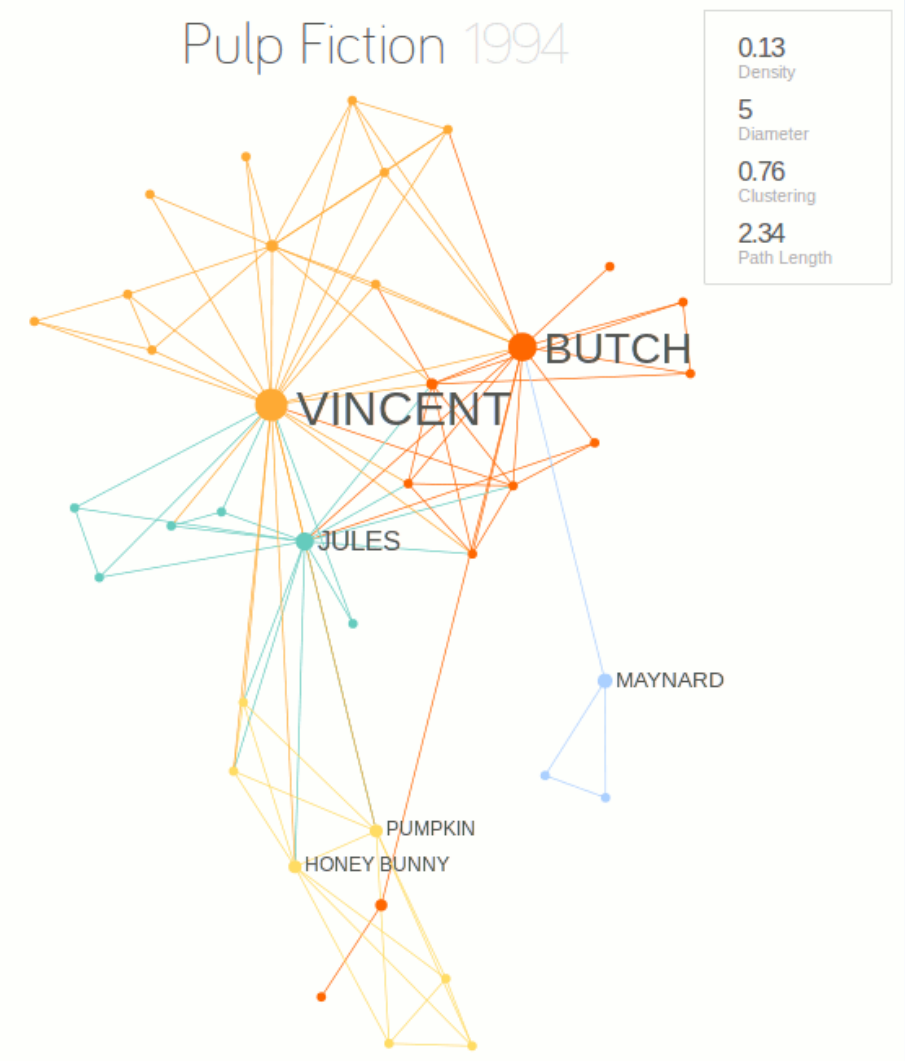

http://moviegalaxies.com/movies/660-Pulp-Fiction

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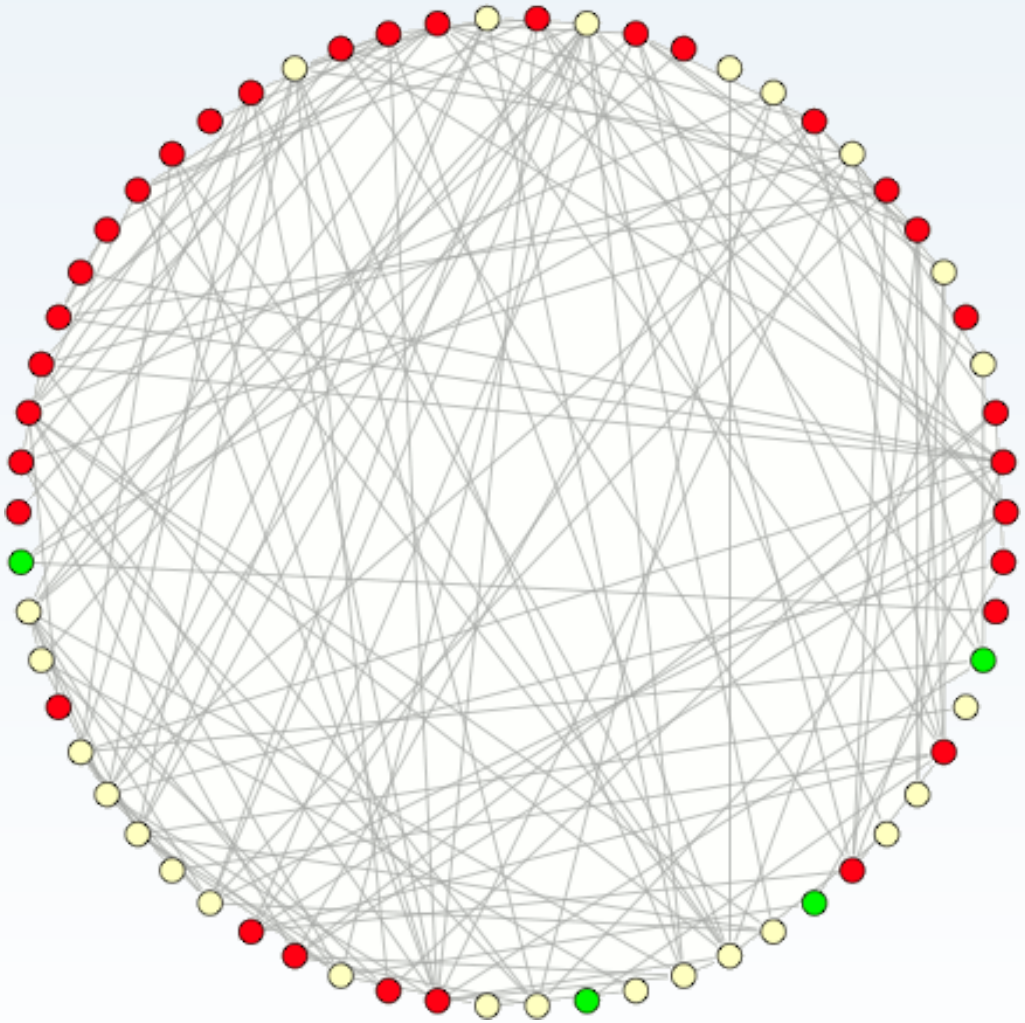
Circular layout

How to reduce the visual clutter?



Examples

- basic layout
- edge binding
- Circos [Krzywinski et al., 2009]

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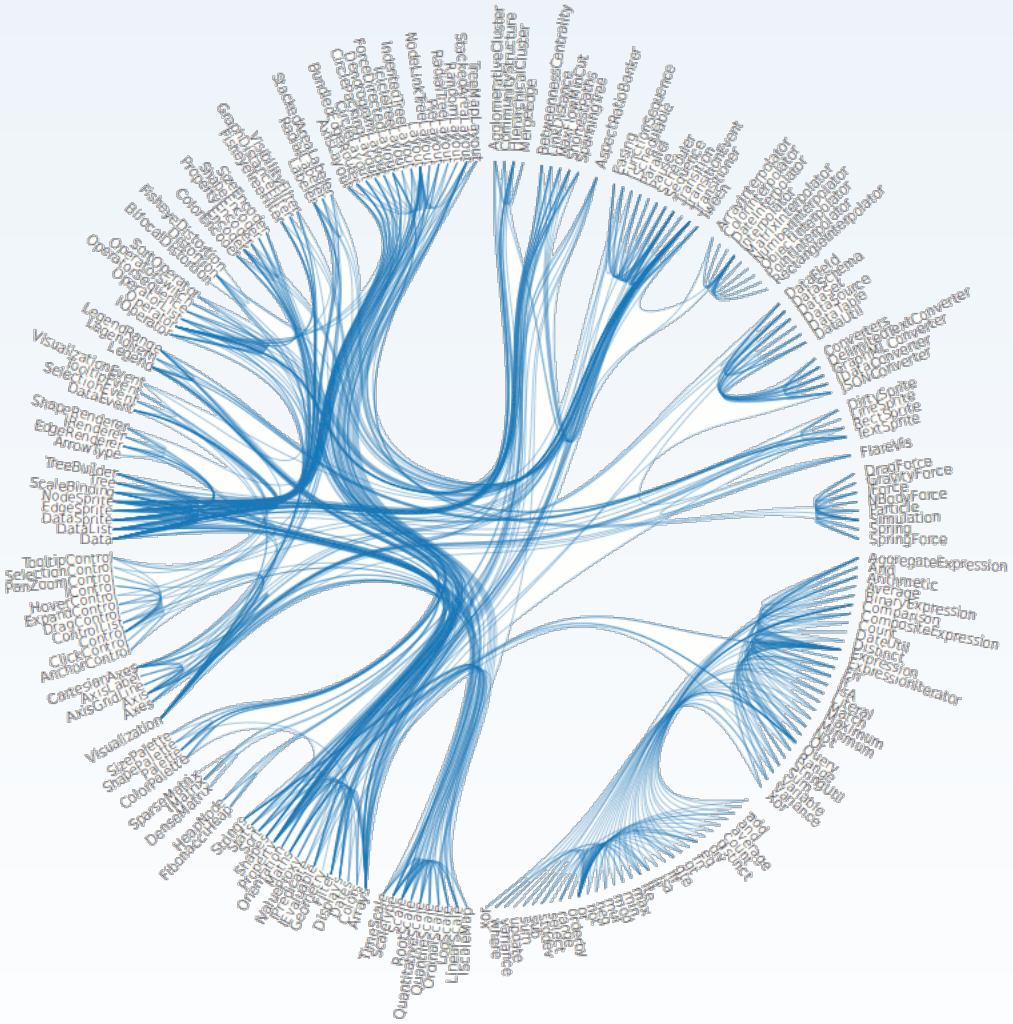

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http://mbostock.github.io/d3/talk/20111116/bundle.html

Circular layout

How to reduce the visual clutter?

	D	E	F
A			
B		10	
C			

http://circos.ca/intro/tabular_visualization/

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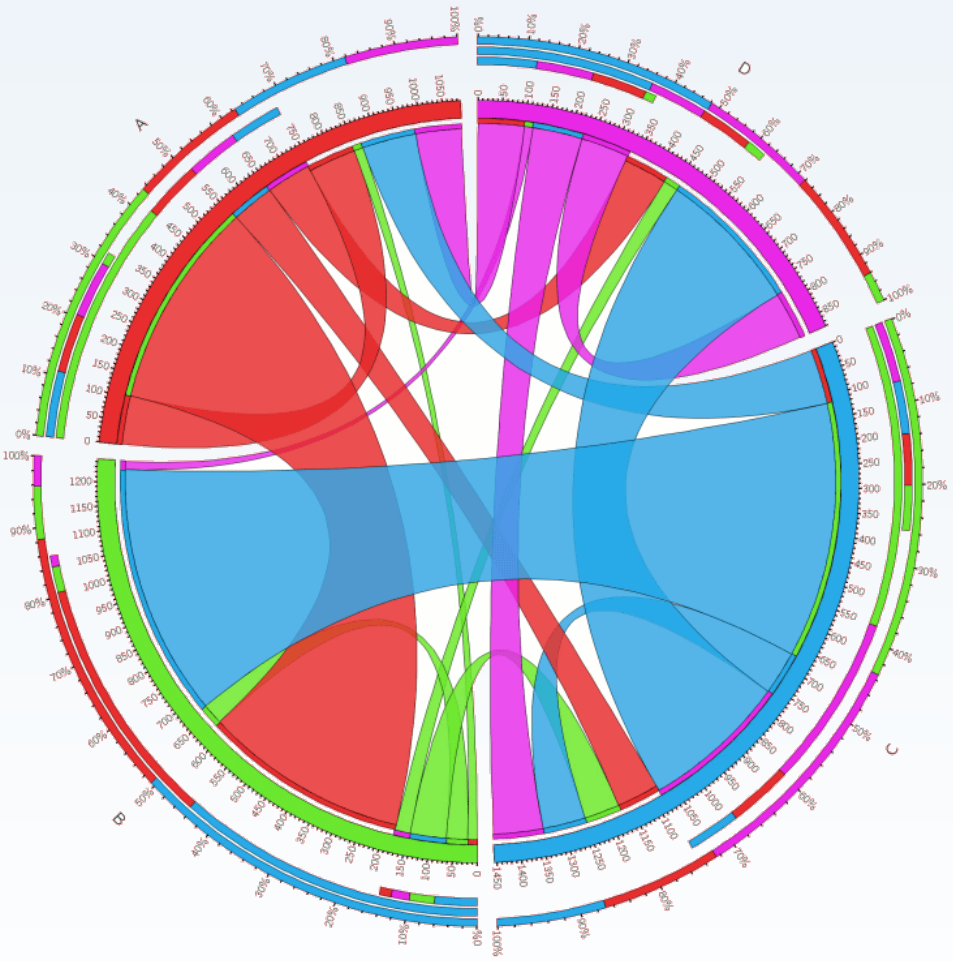

http://mkweb.bcgsc.ca/tableviewer/samples/

Examples

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	A	B	C	D
A	105	450	92	96
B	20	46	78	33
C	118	553	94	317
D	100	18	108	104

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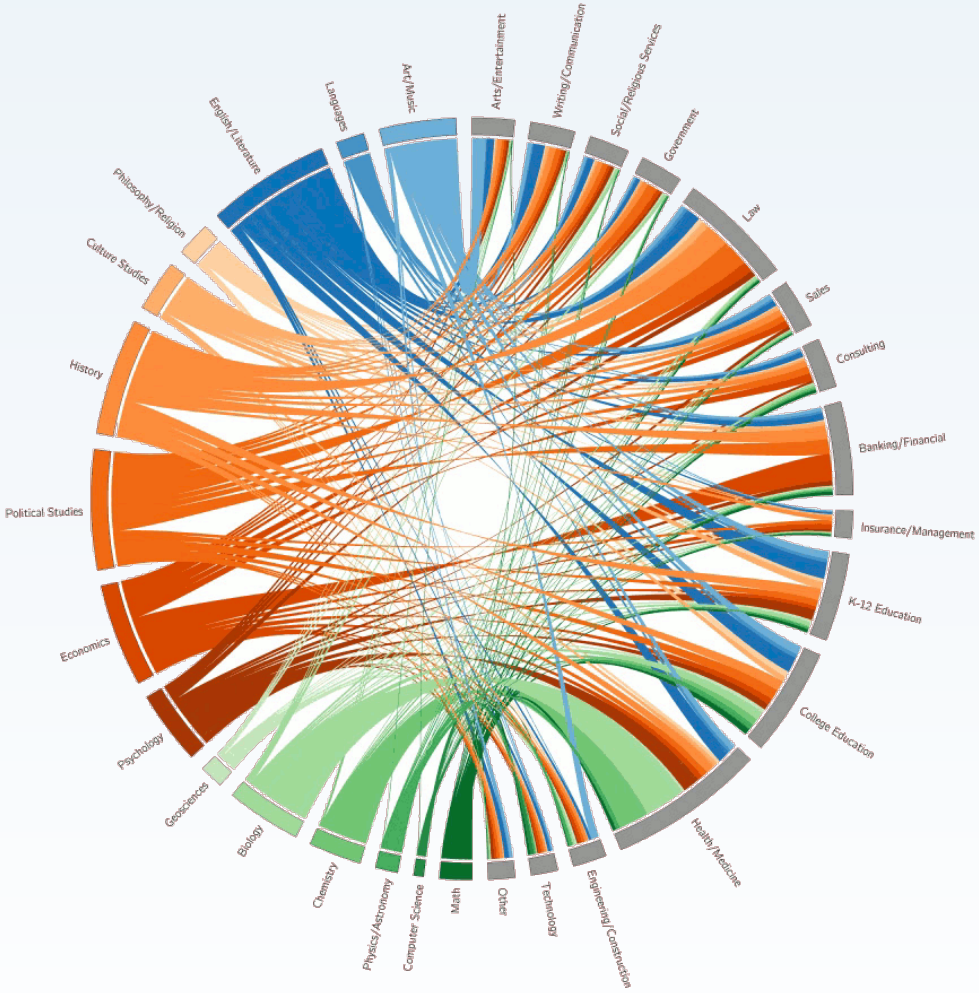

http://web.williams.edu/Mathematics/devadoss/careerpath.html

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Pivot graph

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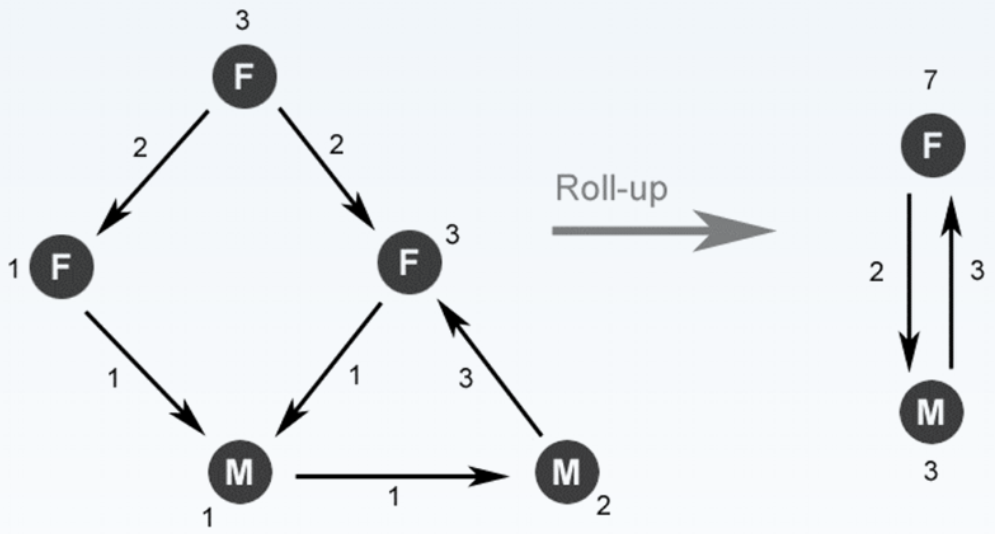

[Wattenberg, 2006]

- nodes roll-up
- network reduction

Communication inside a company

- between offices
- between departments

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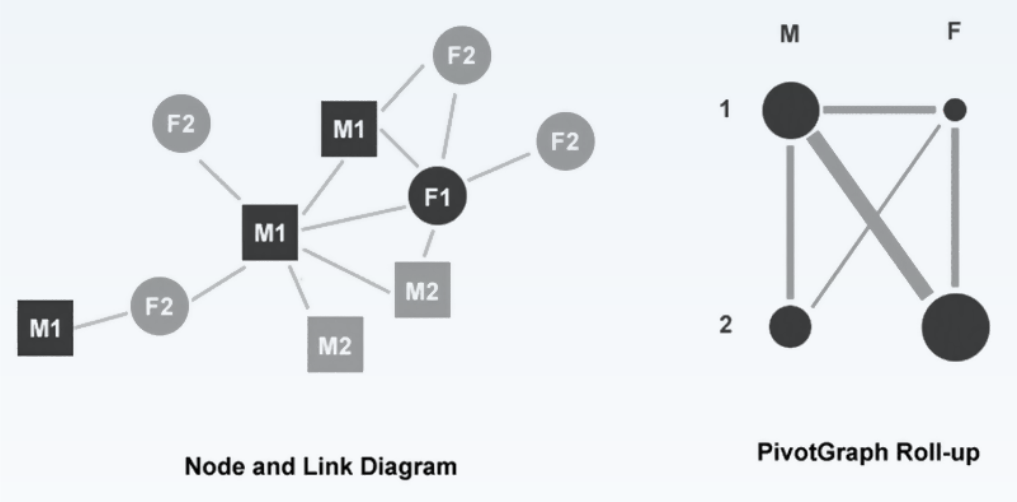

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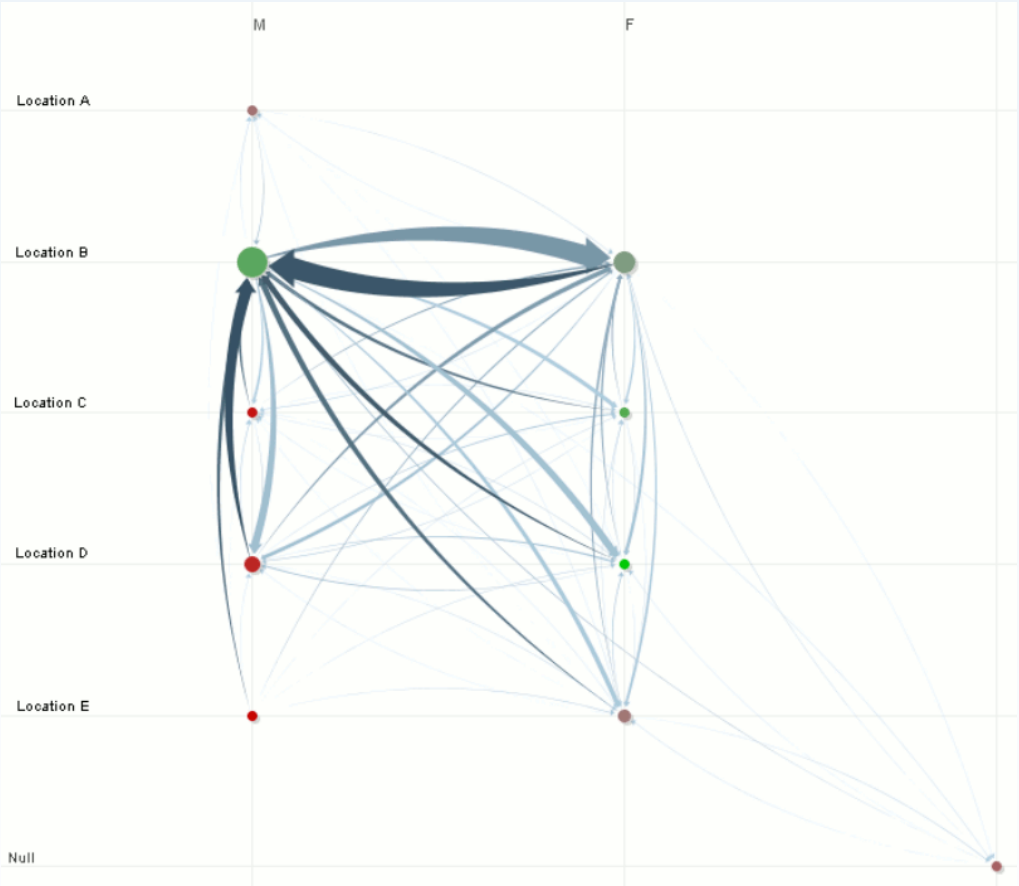

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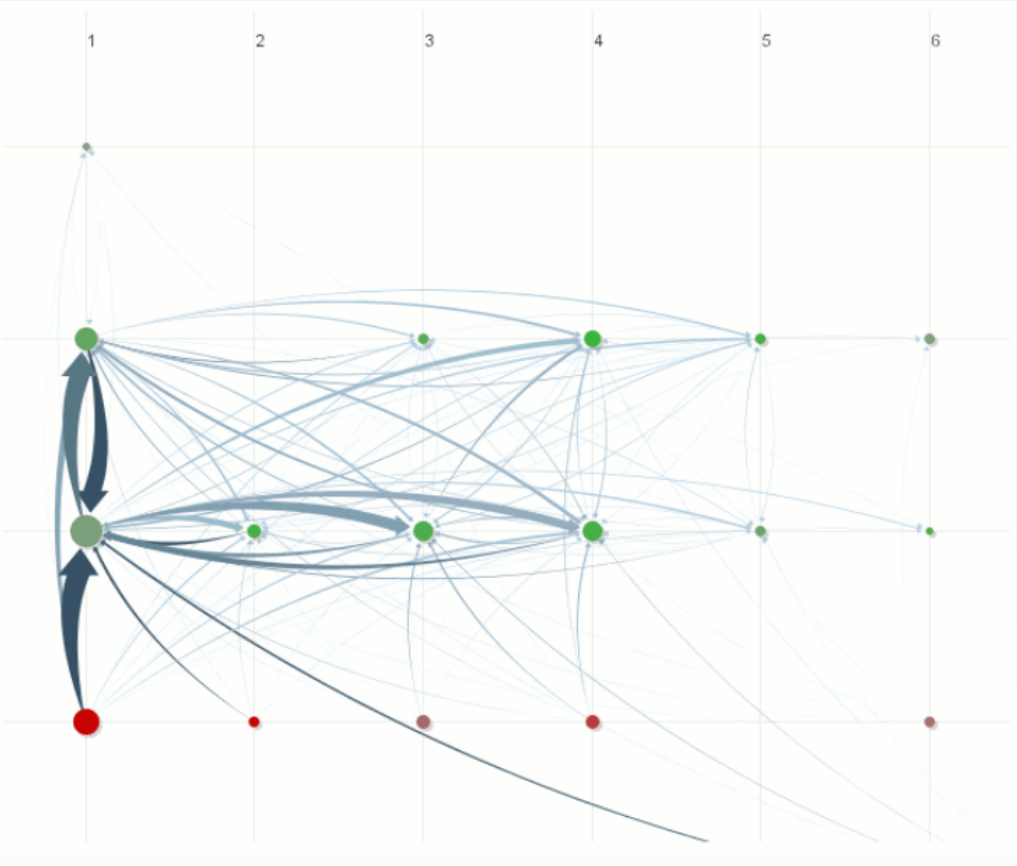

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Hive plot

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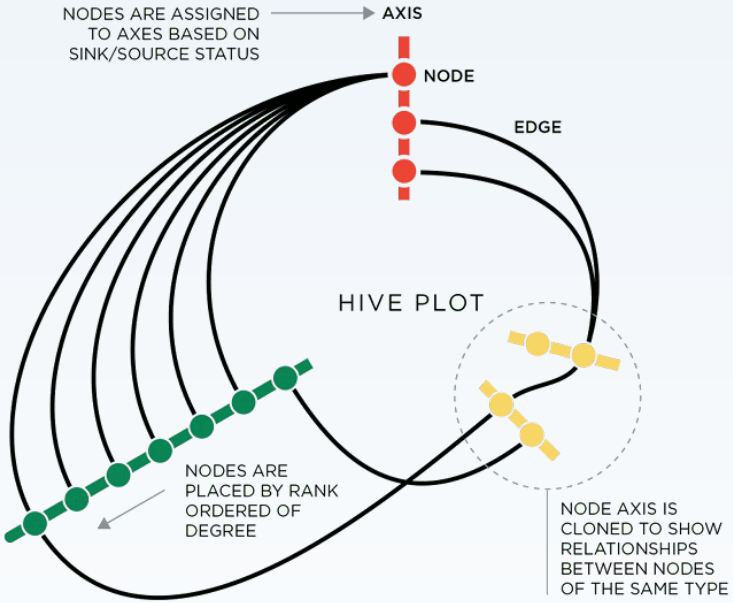

http://www.hiveplot.net/conference/vizbi2011/poster/krzywinski-hiveplot-poster.png

[Krzywinski et al., 2012]

- nodes placed on linear axes
- flexible node → axis assignment and on-axis position

Network comparison

A) Escherichia Coli gene transcription (1k nodes, 3k edges)

B) Linux function calls (12k nodes, 34k edges)

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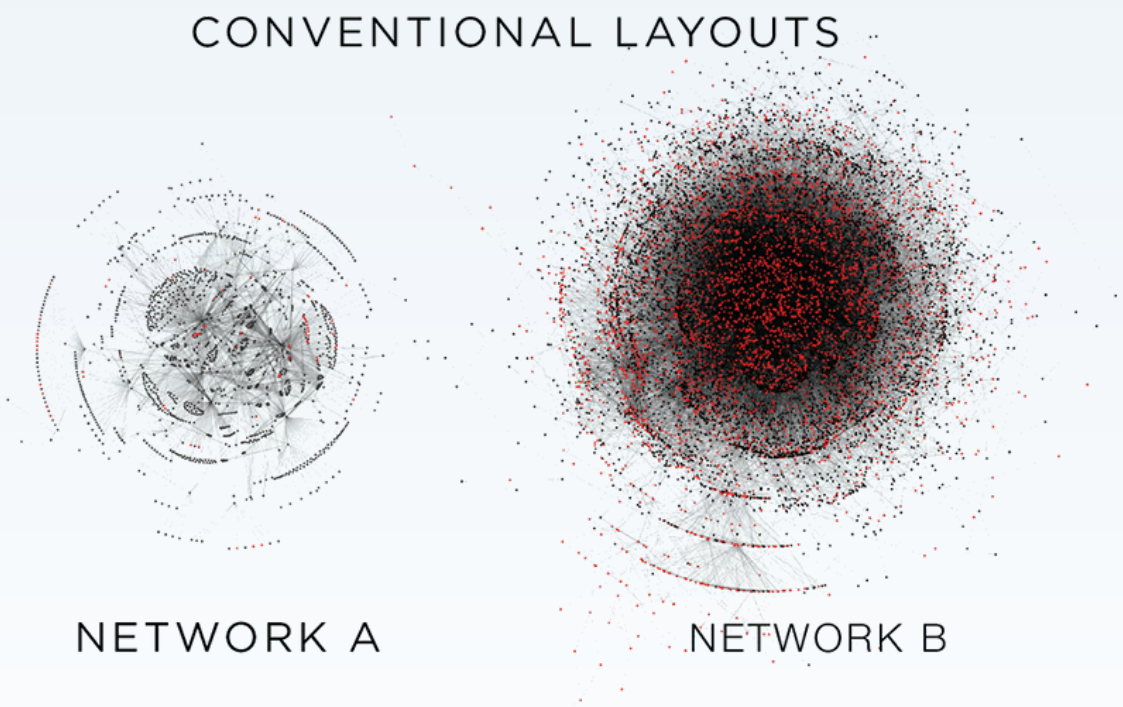

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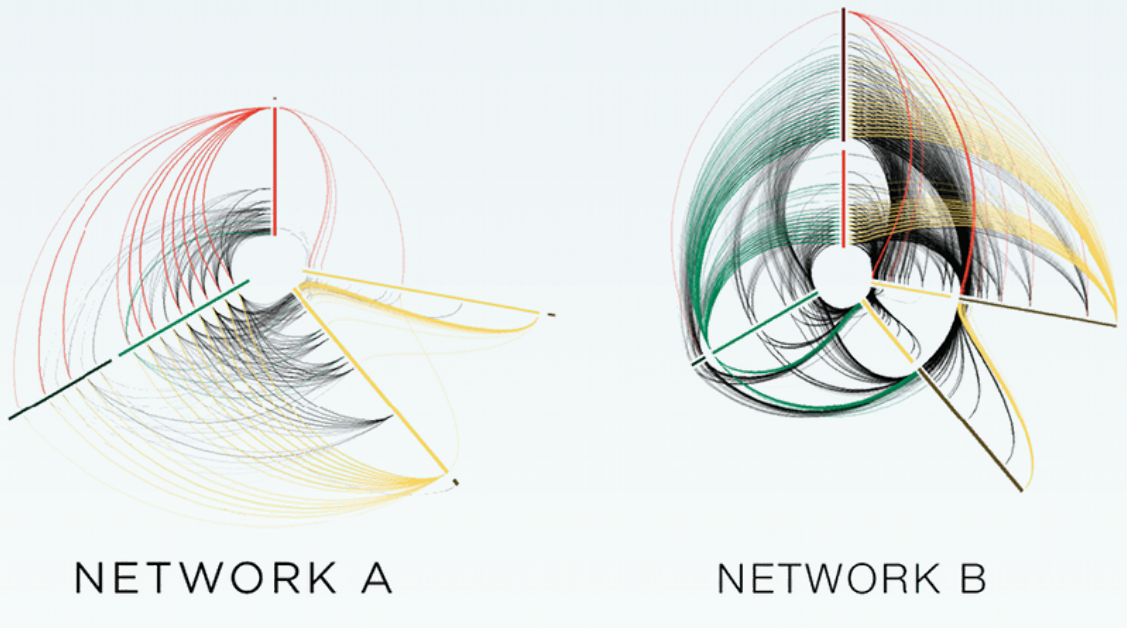

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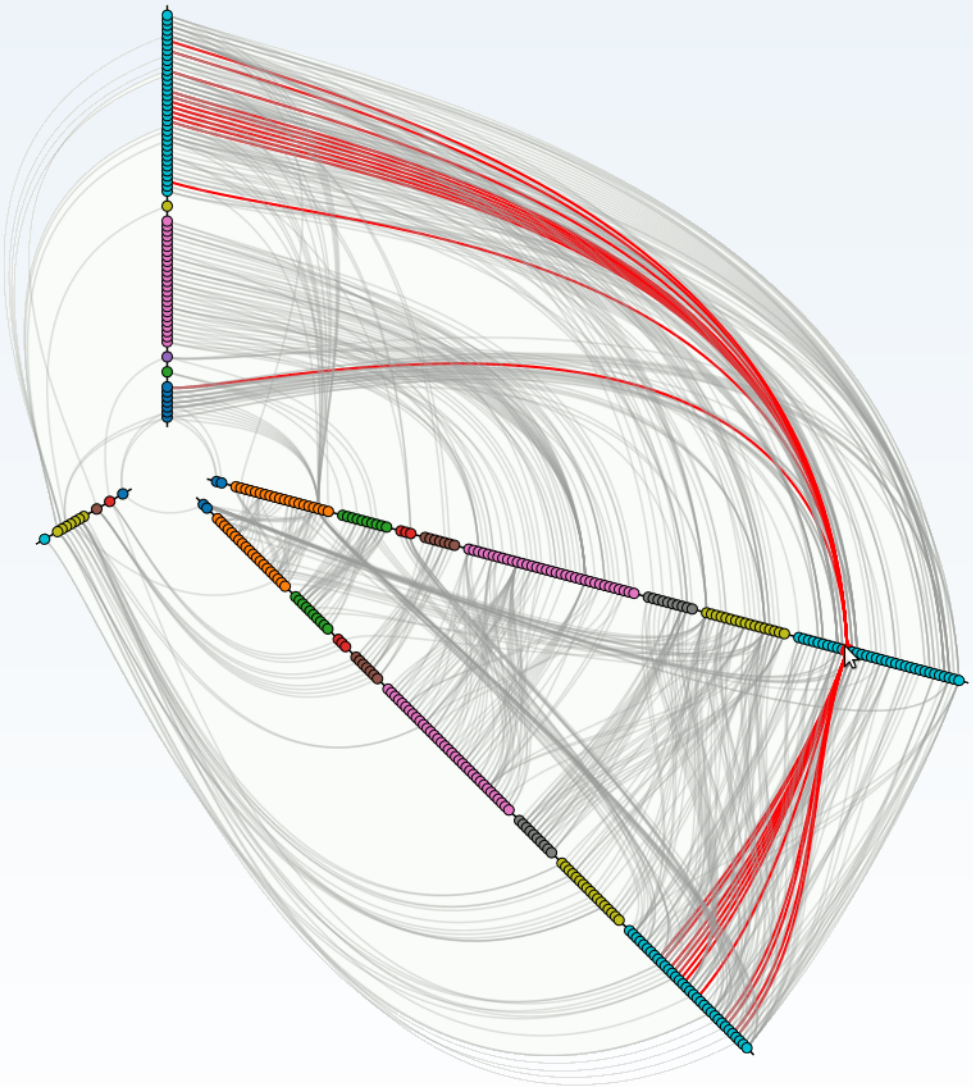

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BioFabric

How to comb the hair ball?

http://www.biofabric.org/gallery/pages/SuperQuickBioFabric.html

[Longabaugh, 2012]

- each **node** is a **horizontal** line
- each **edge** is a **vertical** line
- vertical lines start with a **source node** and end with a **target node**

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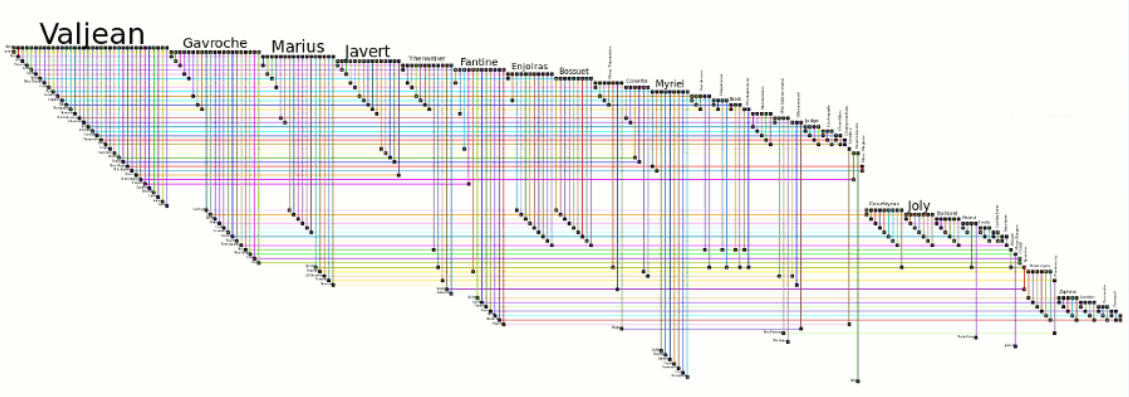

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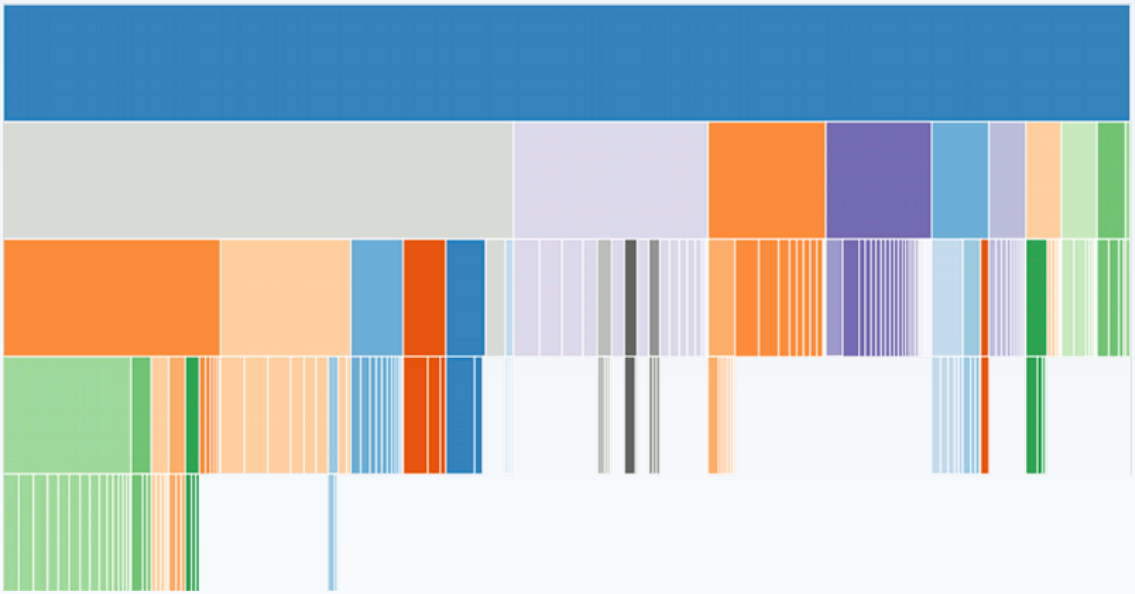
Hierarchical data

Visual ordering



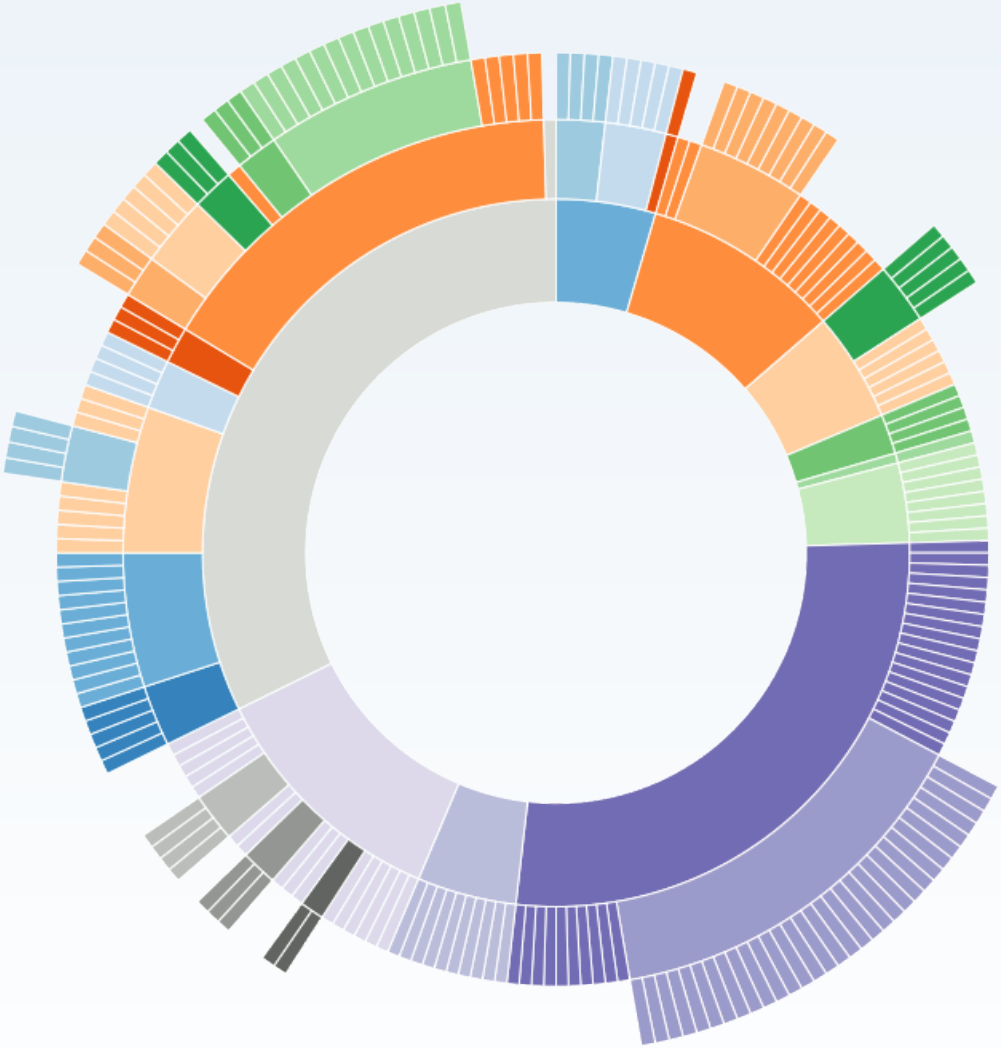
http://bl.ocks.org/mbostock/1005873

Examples

- Icicle
- Sunburst
  [Stasko et al., 2000]

Hierarchical data

Visual ordering



http://bl.ocks.org/mbostock/4063423

"Coffee flavour wheel" by Jason Davies

Examples

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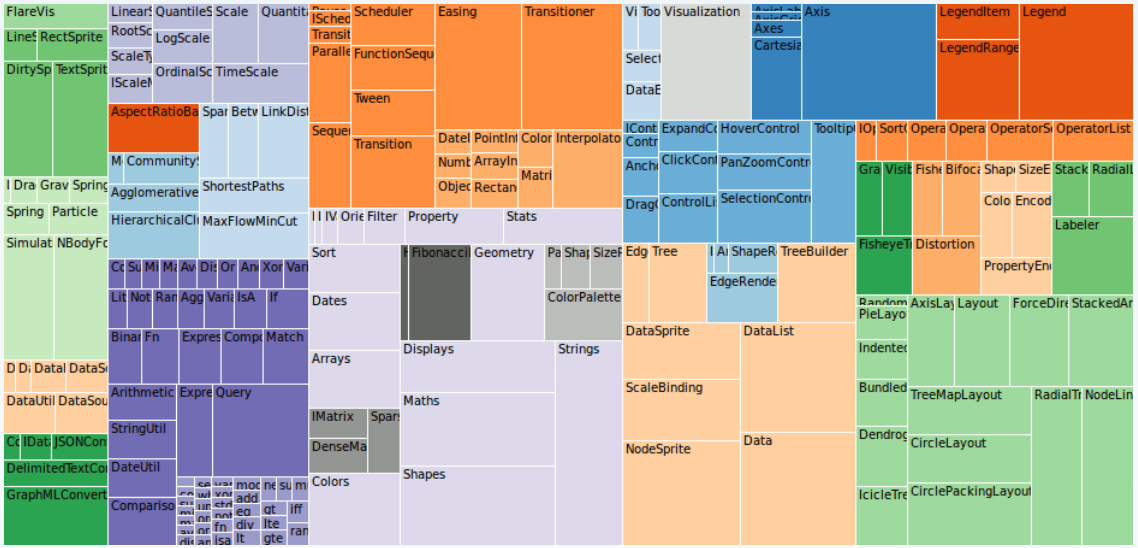
Hierarchical data

Visual subdivision



http://bl.ocks.org/mbostock/4063582

http://mbostock.github.io/d3/talk/20111018/treemap.html

Examples

- Tree map
- Circle packing

Hierarchical data

Visual subdivision

Examples

- Tree map
- Circle packing

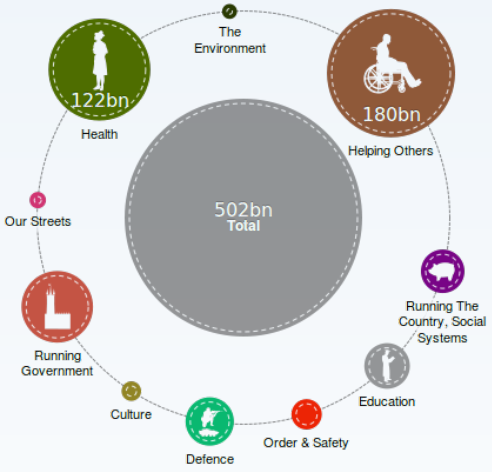
http://bl.ocks.org/mbostock/4063530

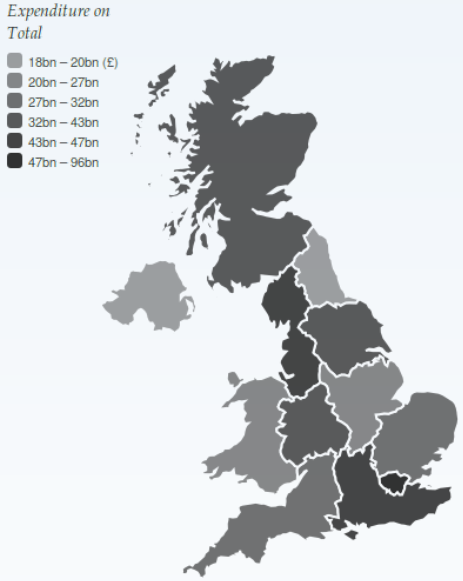
http://mbostock.github.io/d3/talk/20111116/pack-hierarchy.html

http://wimbledon.prcweb.co.uk/playerbubbles.html

Hierarchical data

Interactive exploration





Examples

- Bubble tree
- Social network
- Blogosphere

http://wheredoesmymoneygo.org/bubbletree-map.html

Hierarchical data

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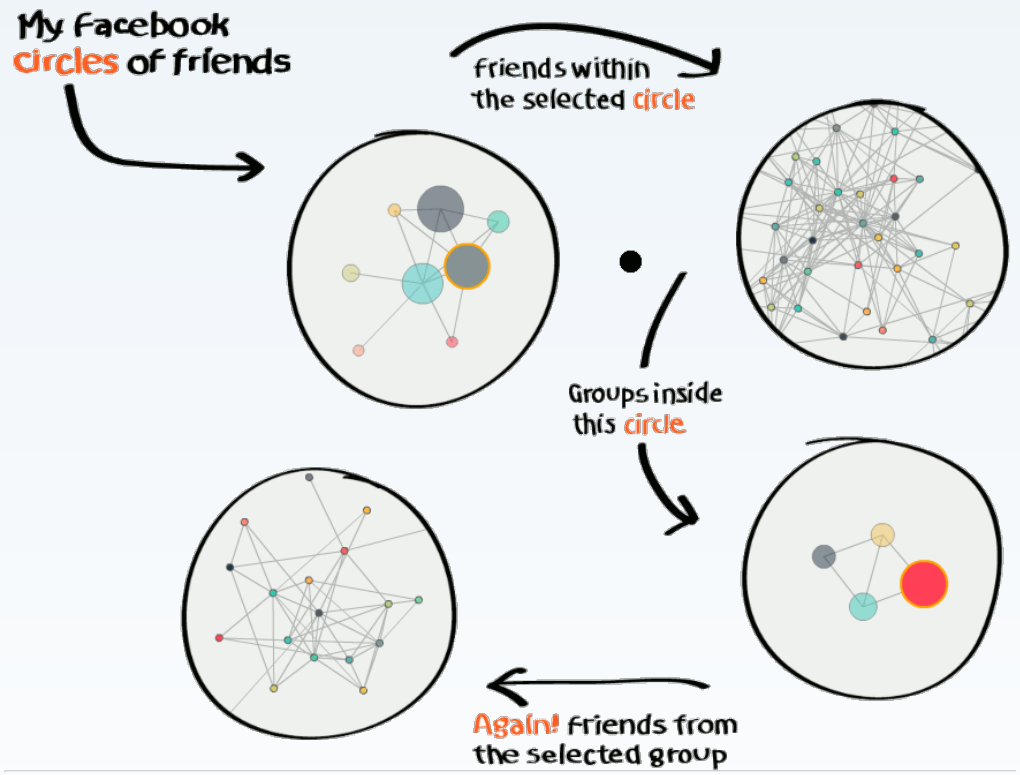

http://www.quadrigram.com/action/exploring-your-social-network

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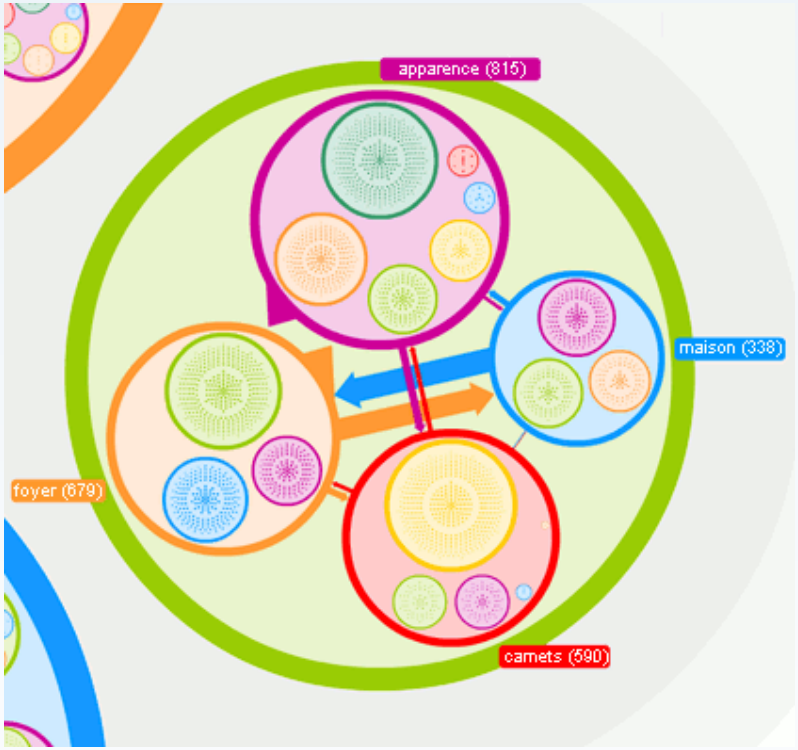
Hierarchical data

Interactive exploration



http://linkfluence.com

Examples

- Bubble tree
- Social network
- Blogosphere

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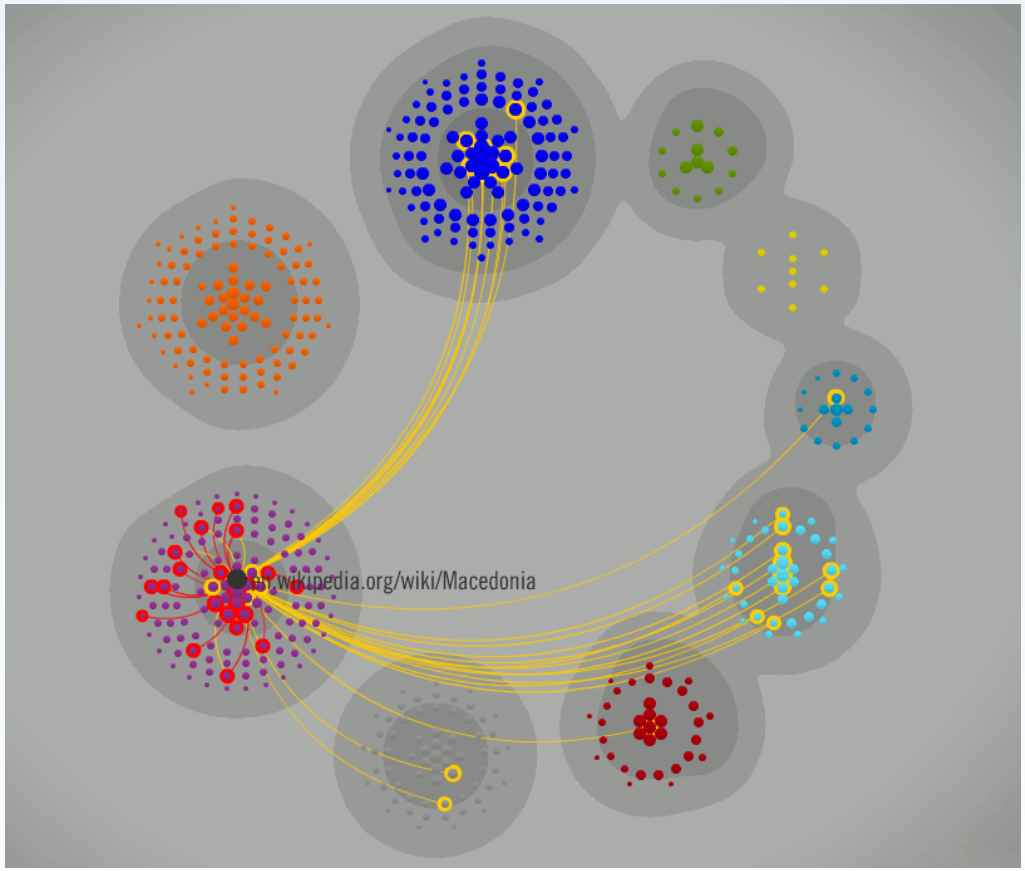

Examples

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http://www.theguardian.com/news/datablog/interactive/2011/sep/07/norway-breivik-manifesto-mapped

Summary

Conclusions

- network visualisation is not just about nodes and edges
- visual aggregation improves readability
- the future of interactive visualisation starts now

My goals for the future

- bubble based hierarchical network explorer
- with context depended interactive connections

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Thank you!

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Pioneering research and skills

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