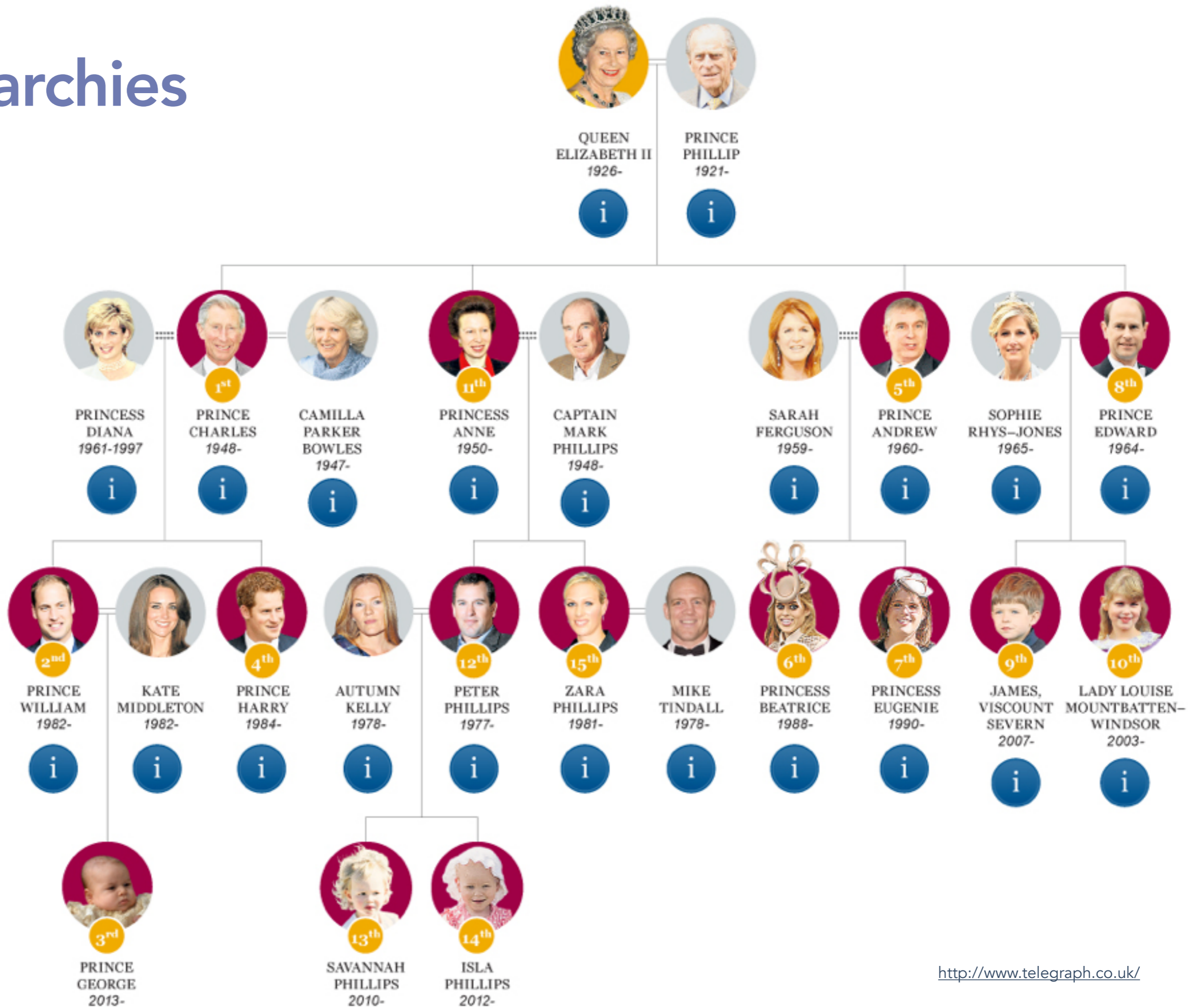


Hierarchies, Graphs, and Networks (oh my)

C. Andrews

2016-04-17

Hierarchies

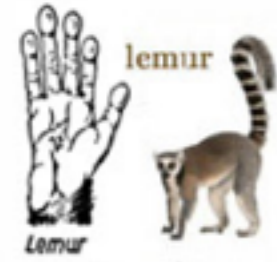


Primate Hands Family Tree

www.handresearch.com (2013)



long-nosed monkey



guenon monkey



Prosimians

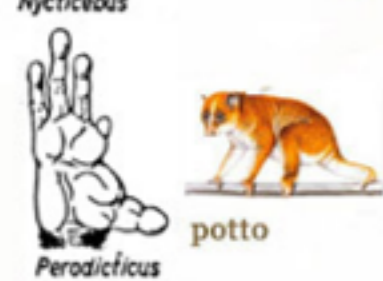
Old World monkeys

Human Apes

Great Human apes

gorilla

chimpanzee (+ bonobo)



Primate Hands: The Family Tree

New World monkeys

capuchin monkey
Cebus

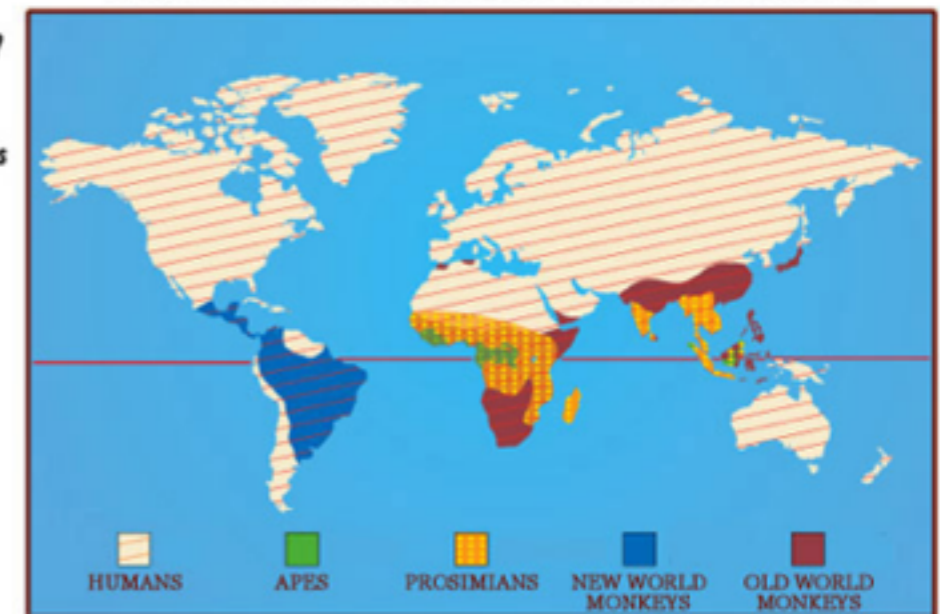
gibbon
Hylobates



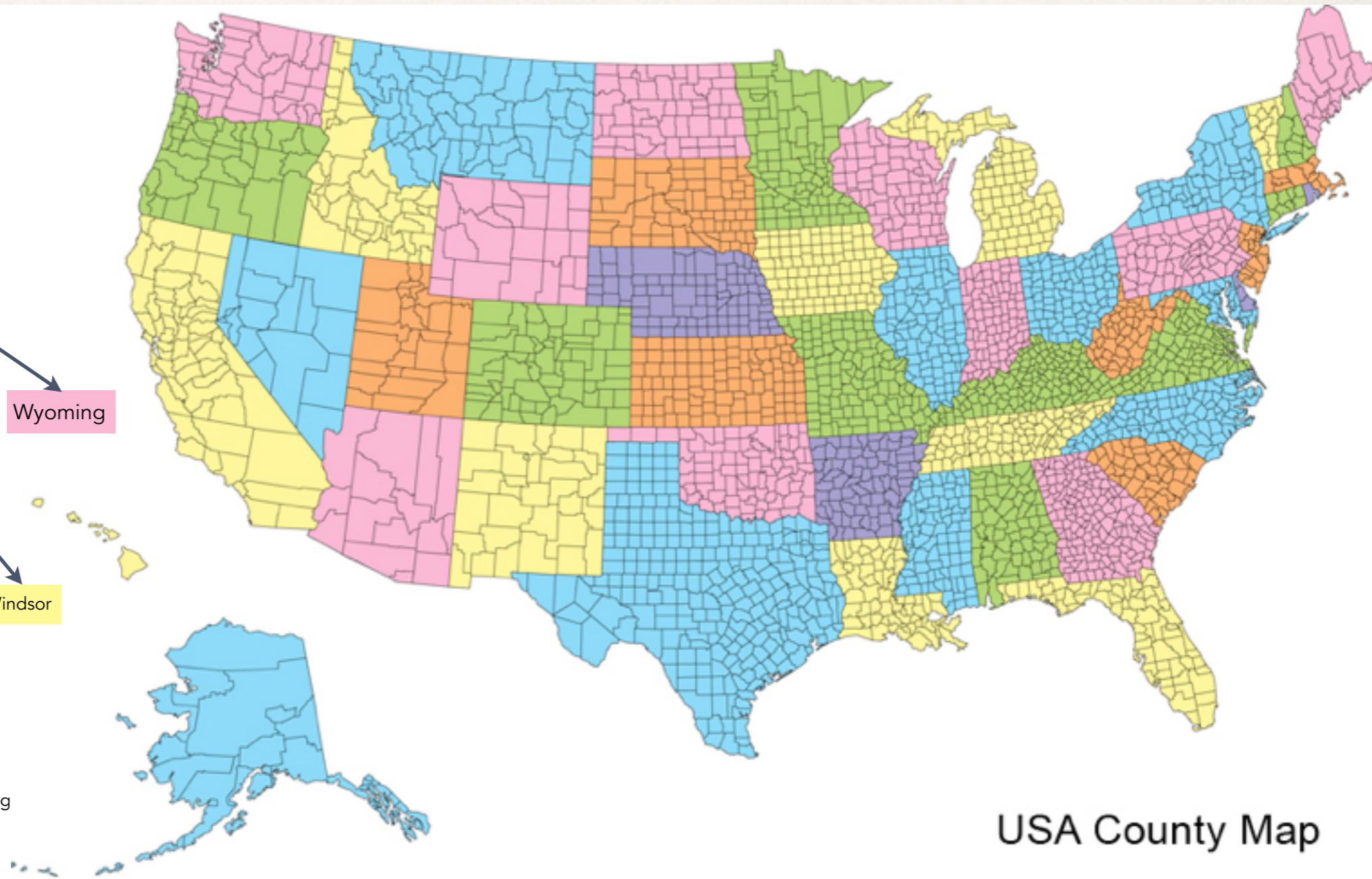
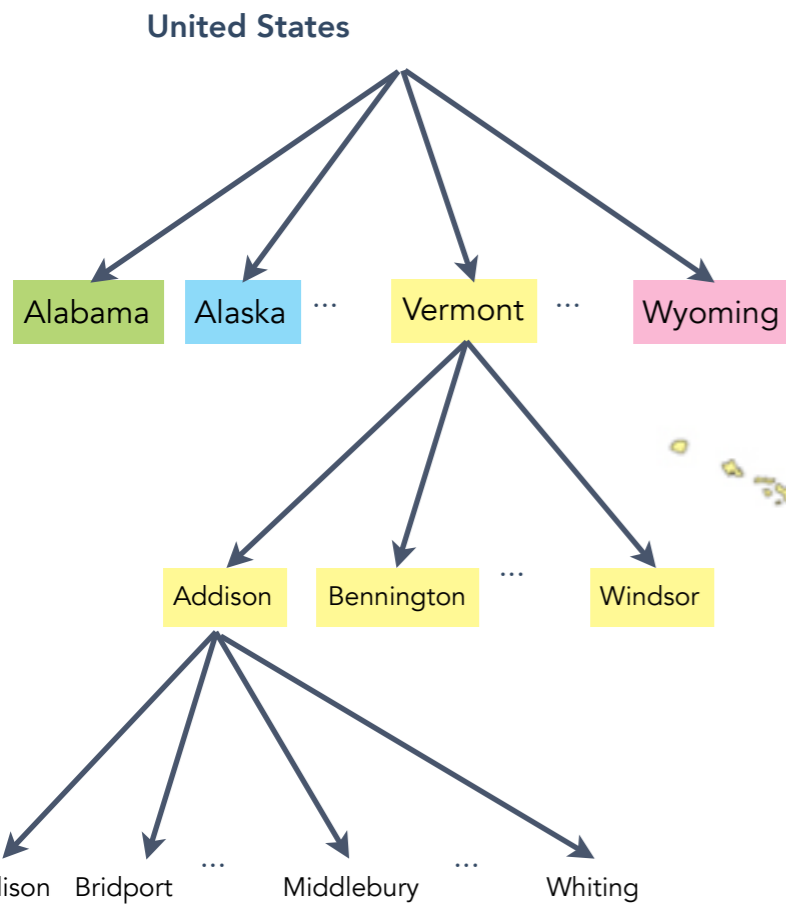
tamarin monkey



PRIMATE FAMILY DISTRIBUTED AROUND THE WORLD



Hierarchies

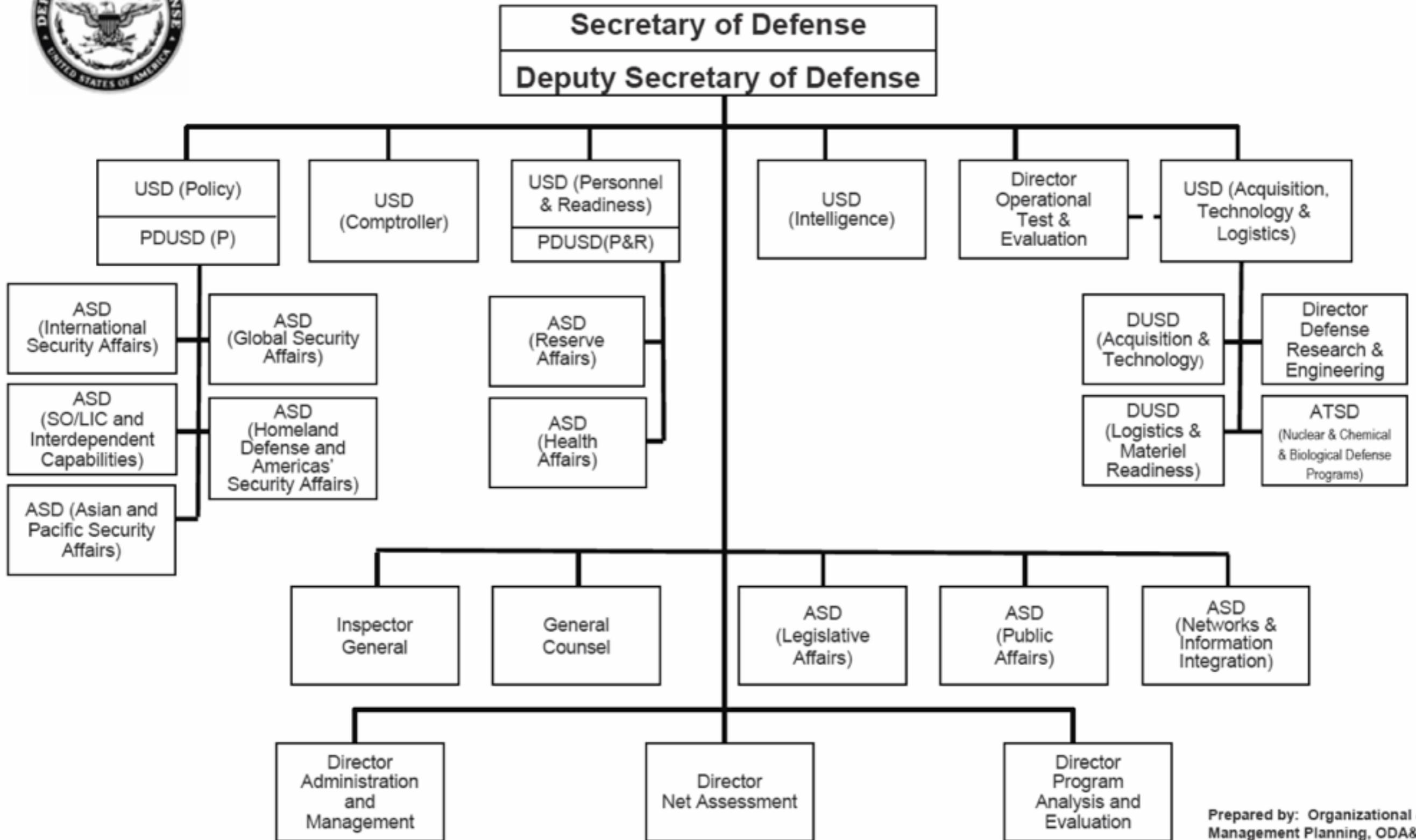


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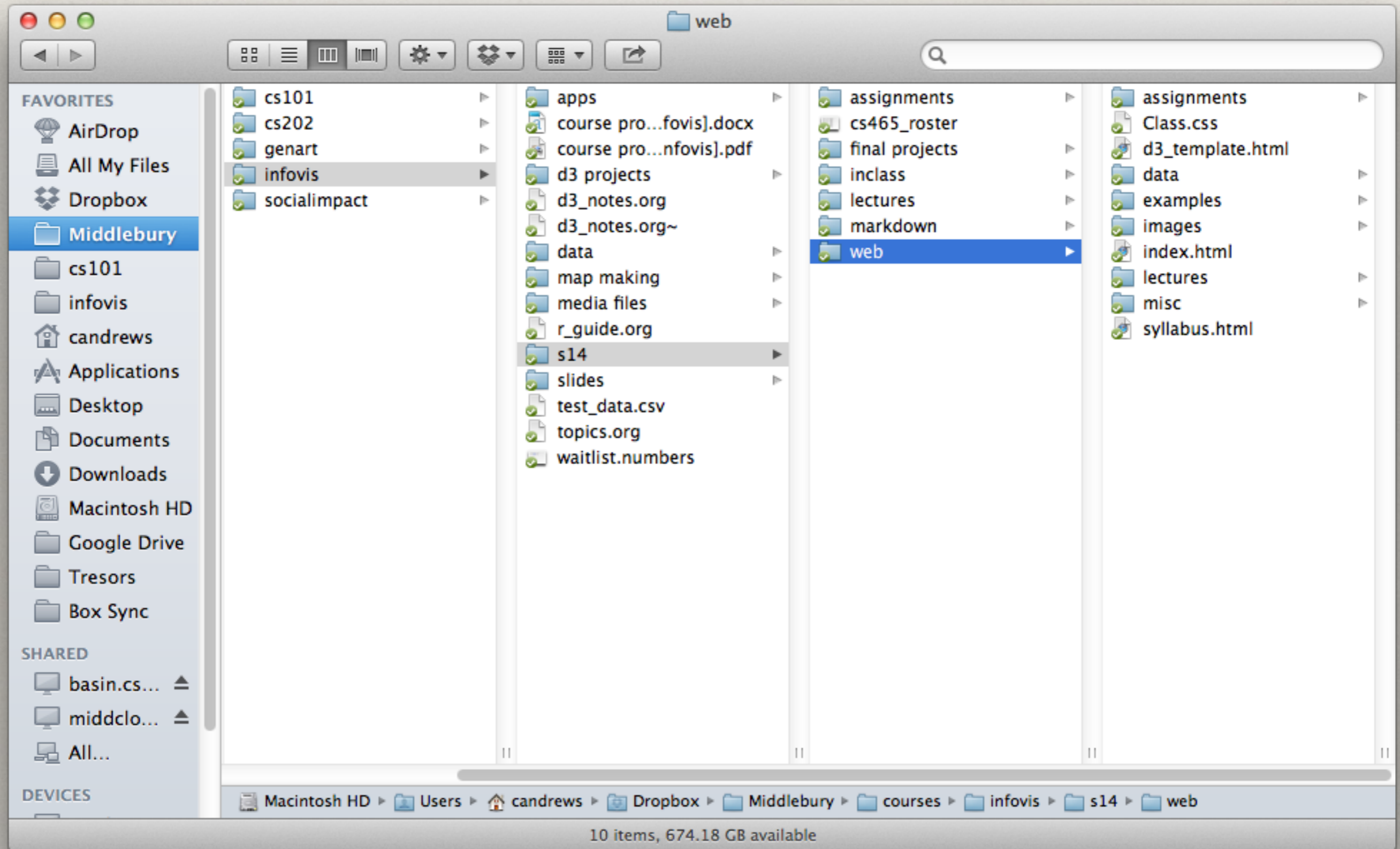
Hierarchies



Office of the Secretary of Defense

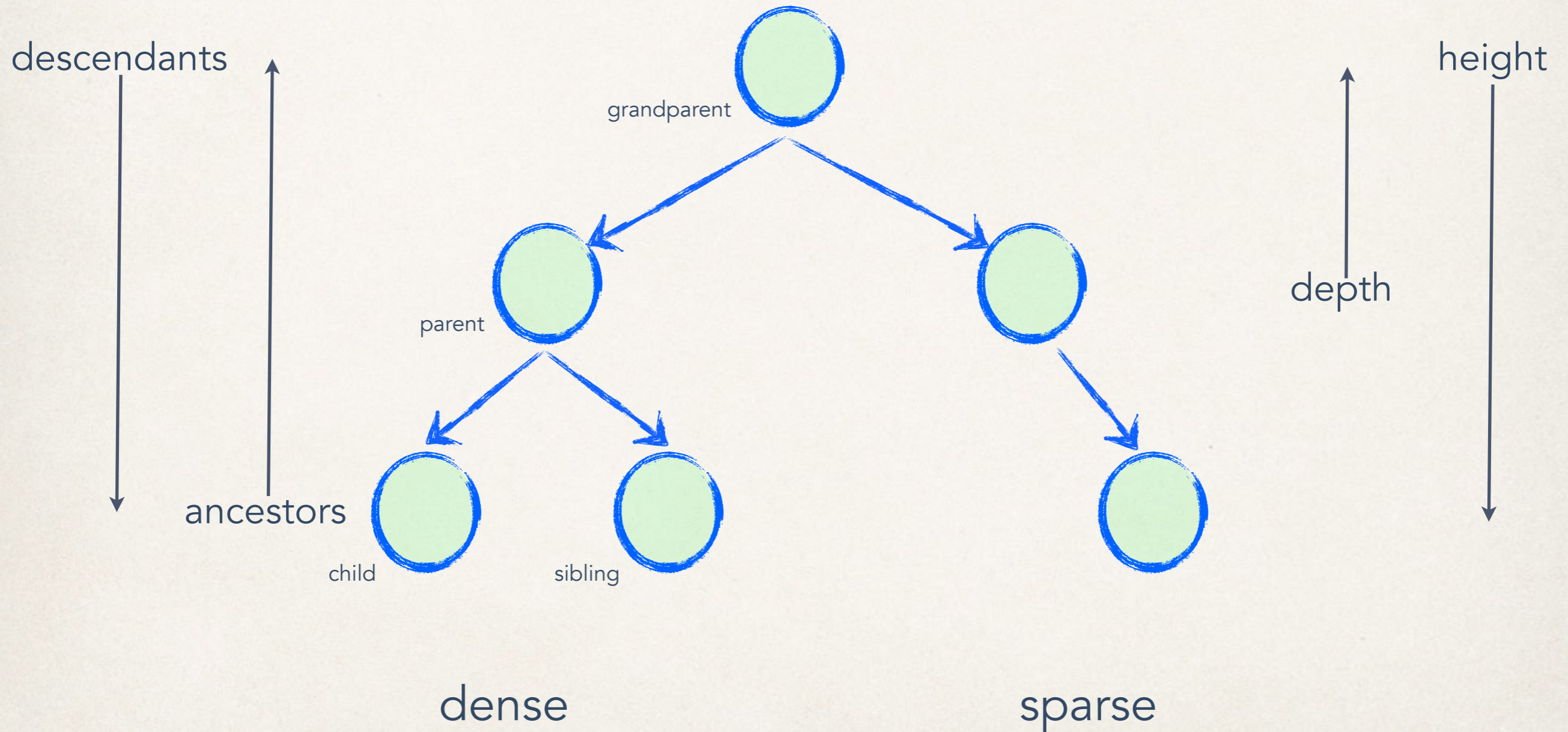


Hierarchies



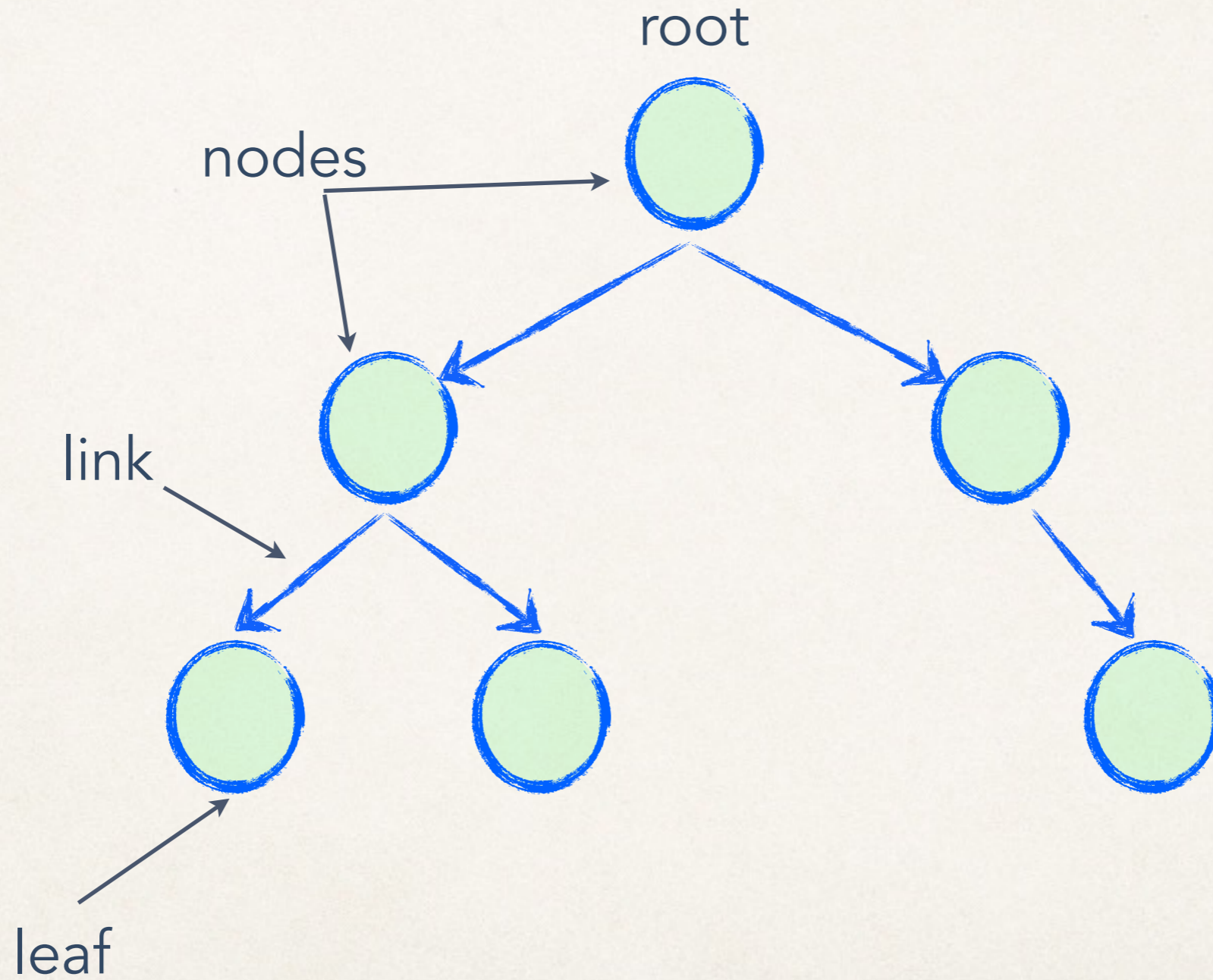
What are we trying to discover?

It is all about structure and relationships



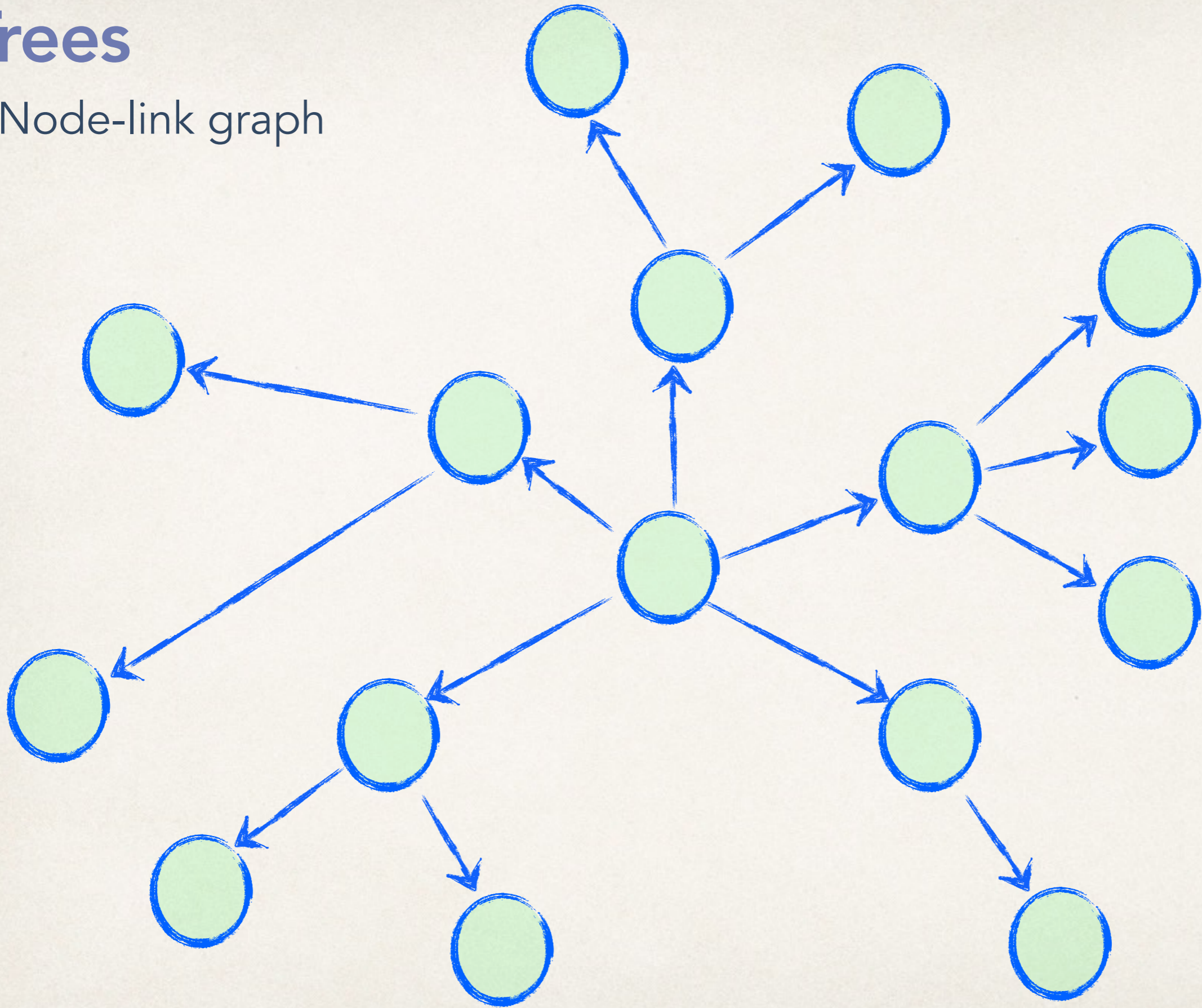
Trees

Node-link graph



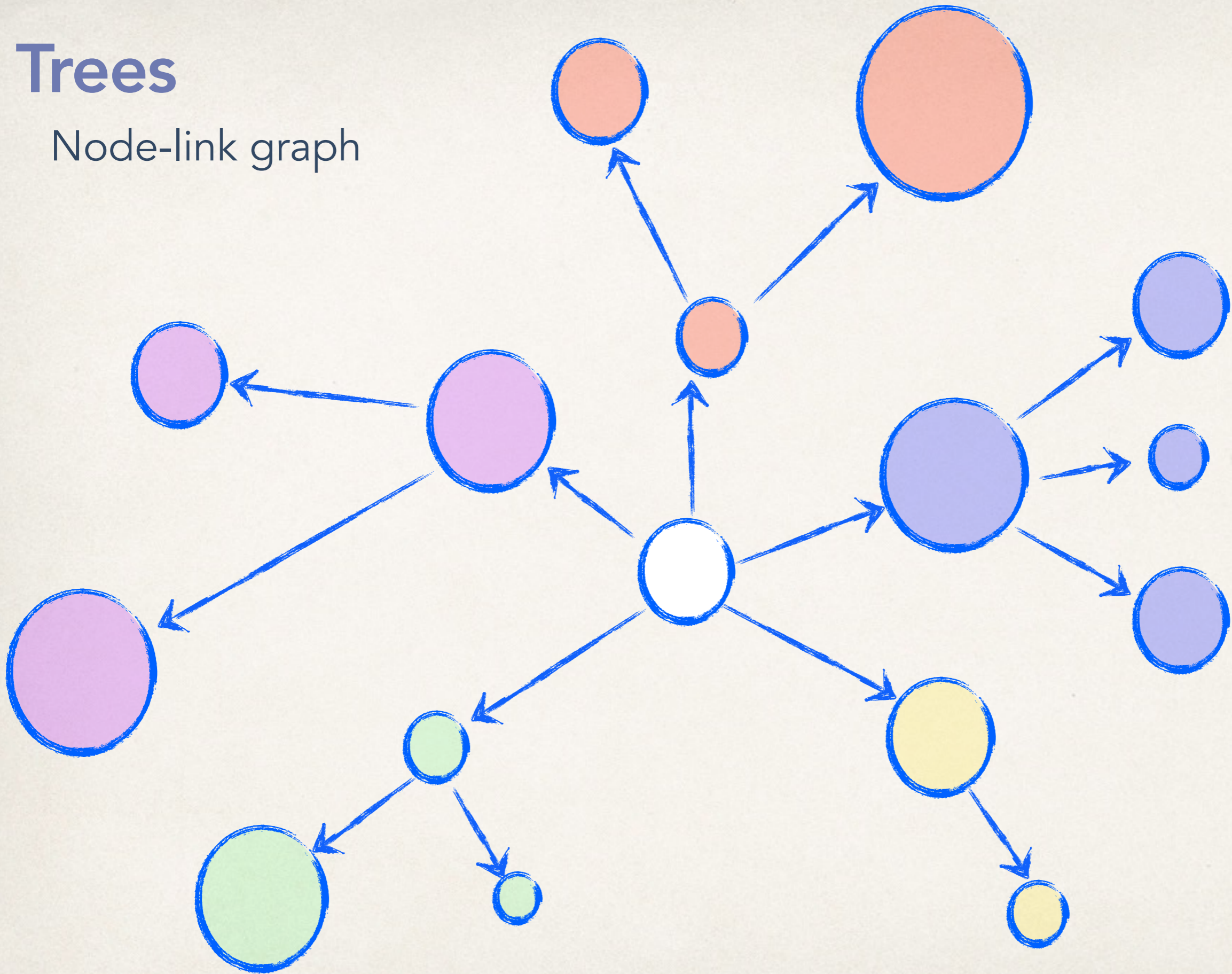
Trees

Node-link graph



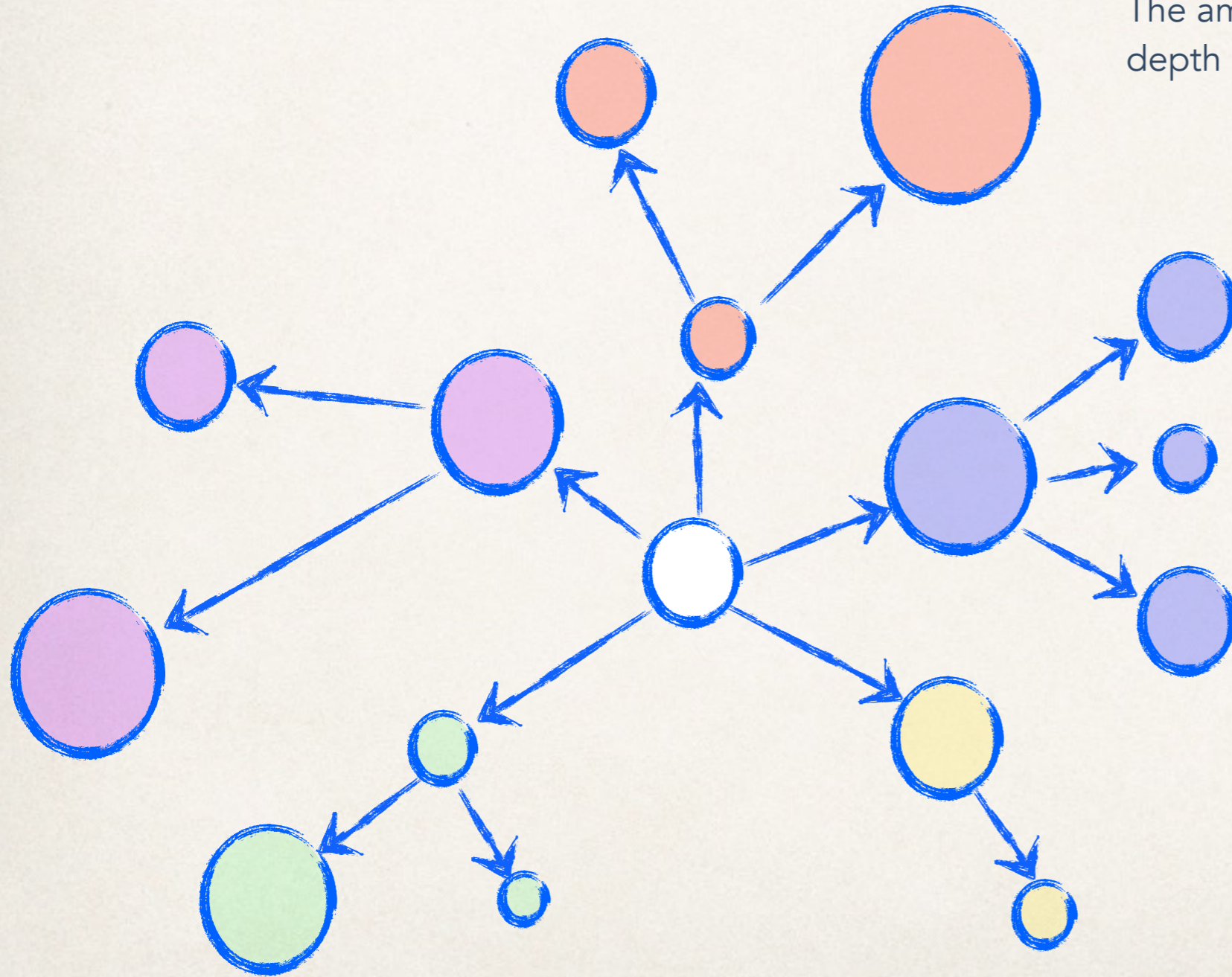
Trees

Node-link graph



Trees

Node-link graph



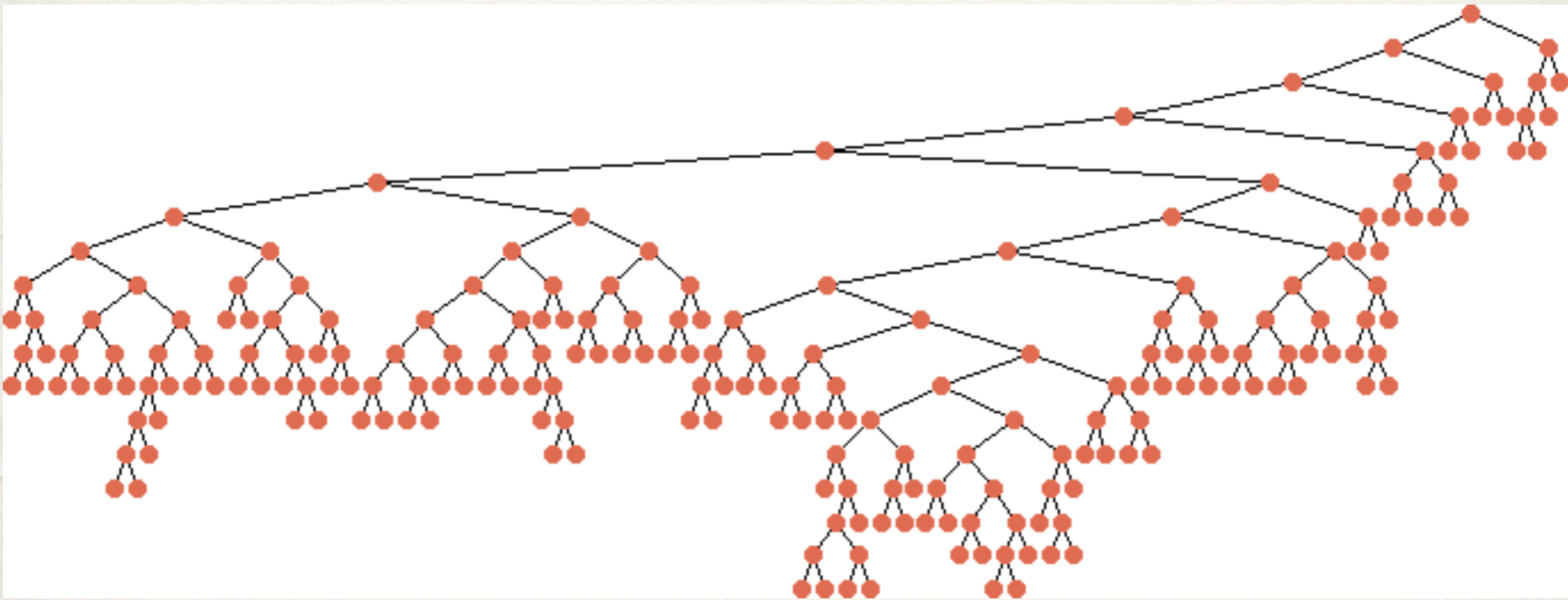
Challenges

We need to display both structure **and** data

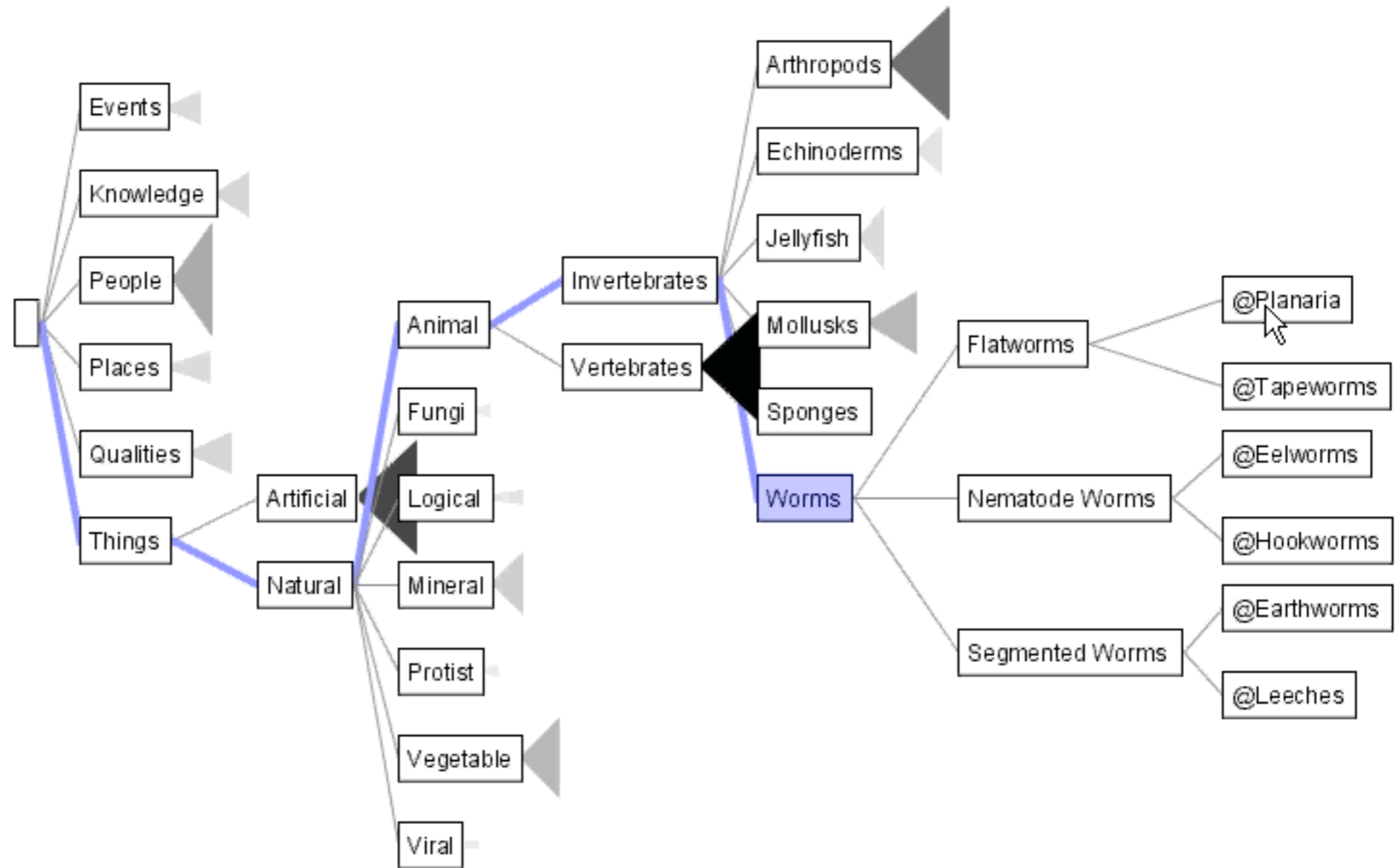
Structure consumes space

The amount of data grows exponentially with the depth

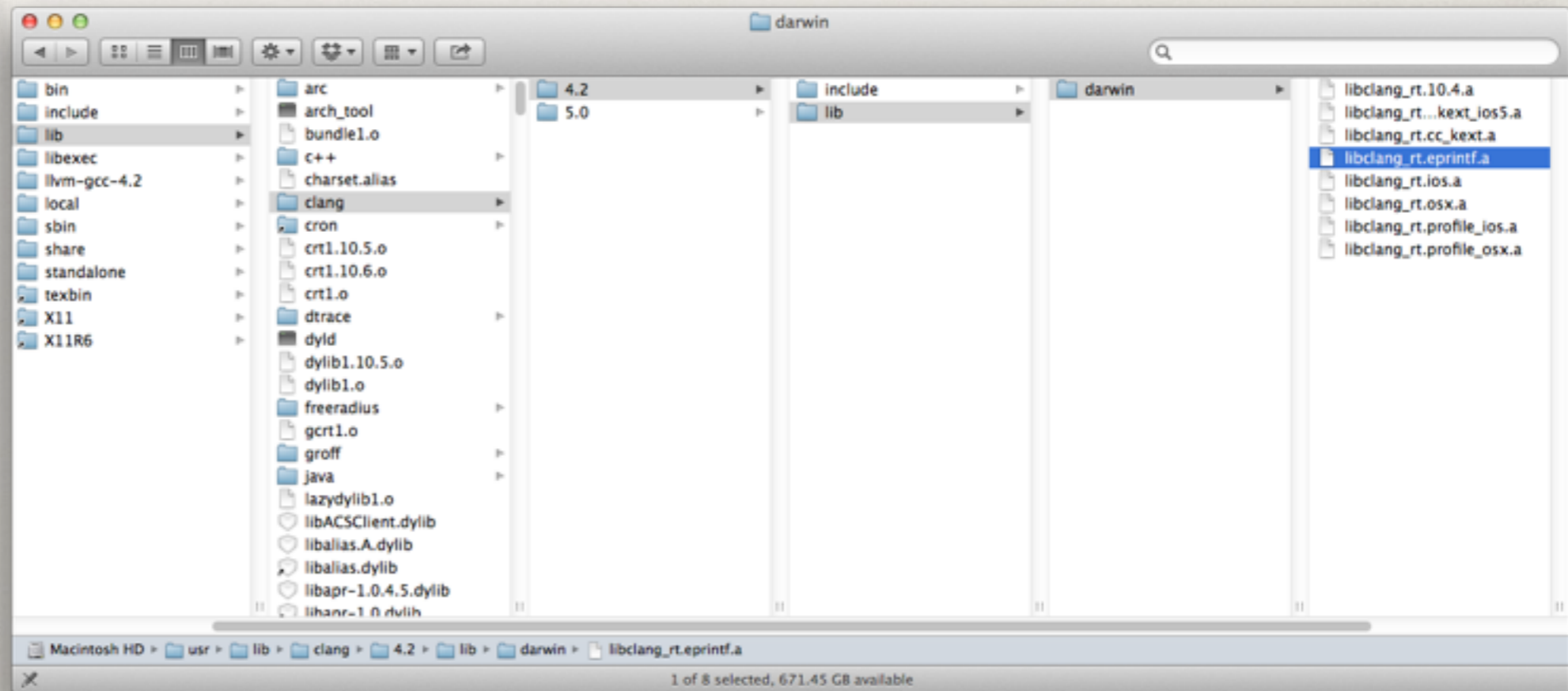
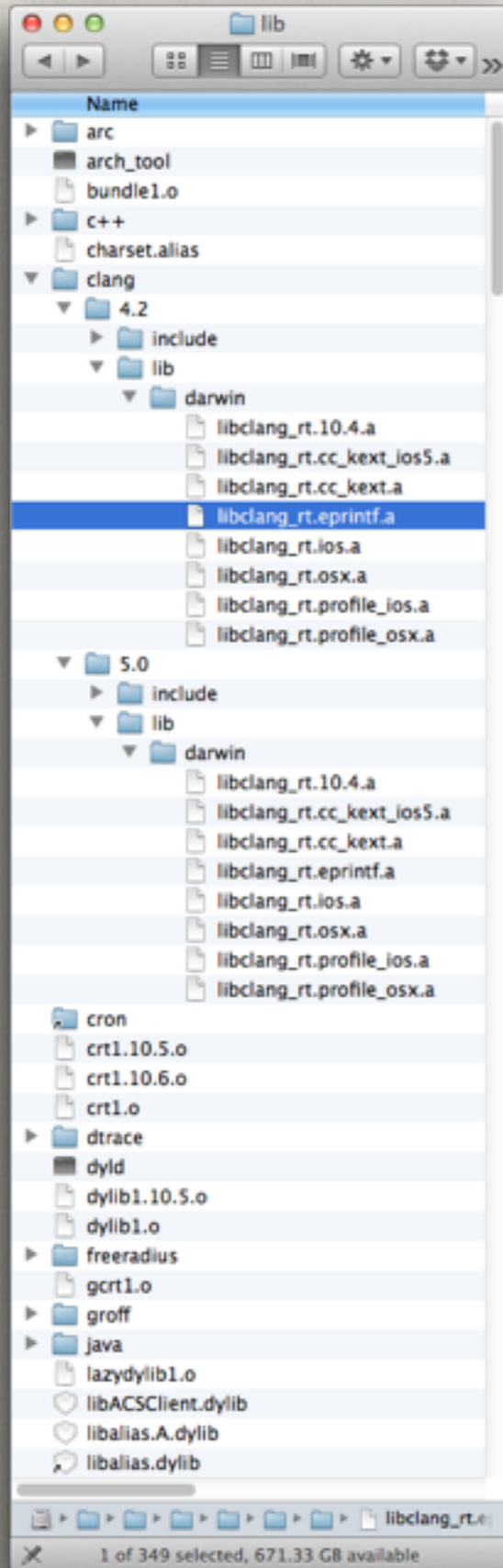
Conventional tree visualization



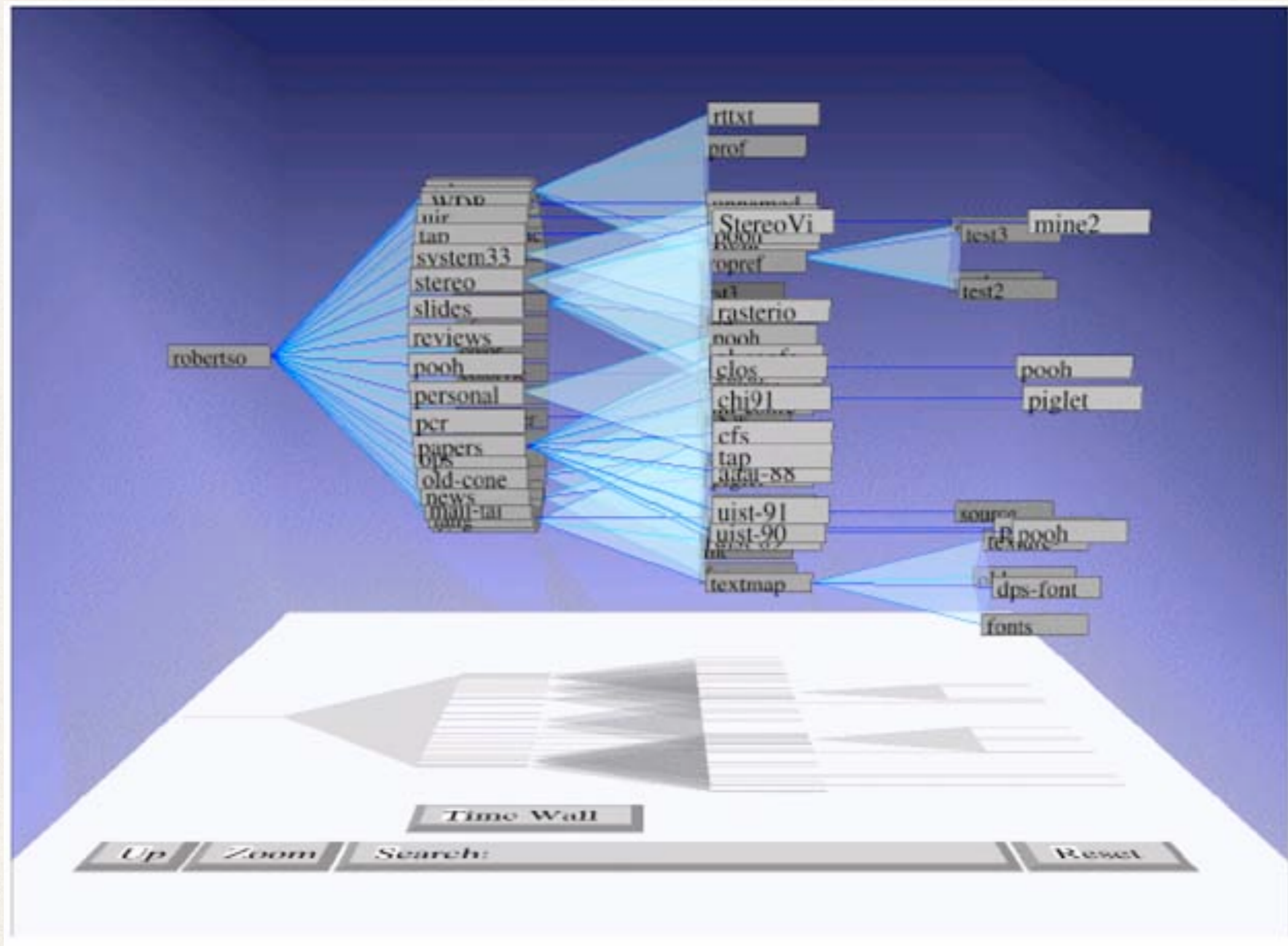
SpaceTree



Two views of a tree



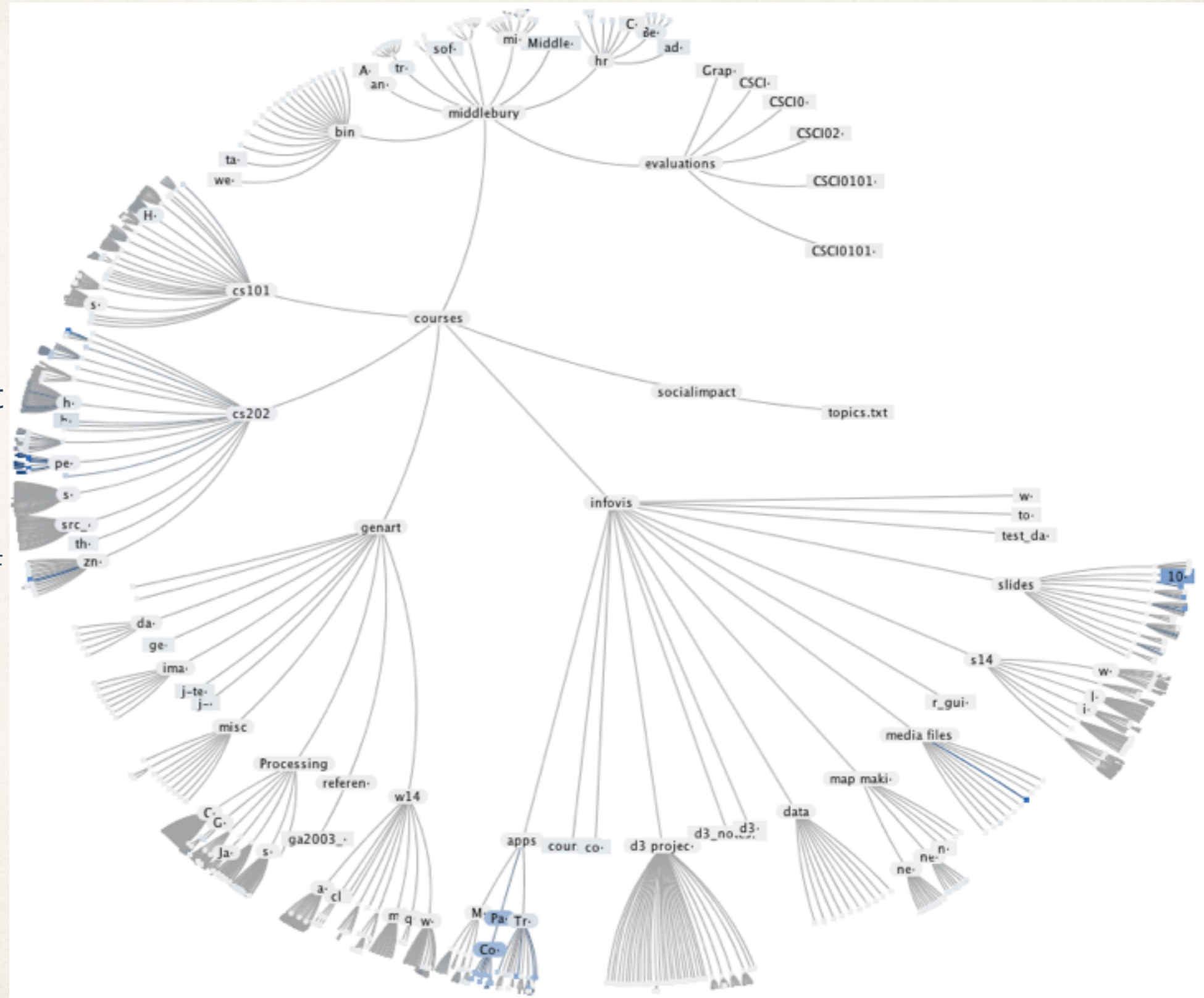
Cone Trees



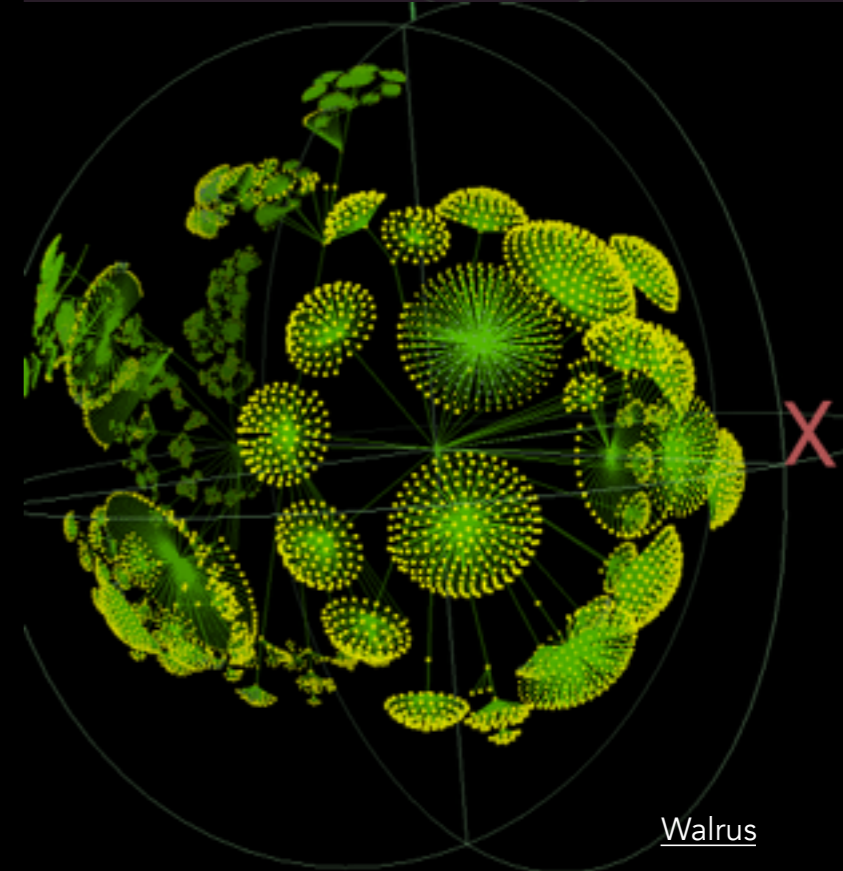
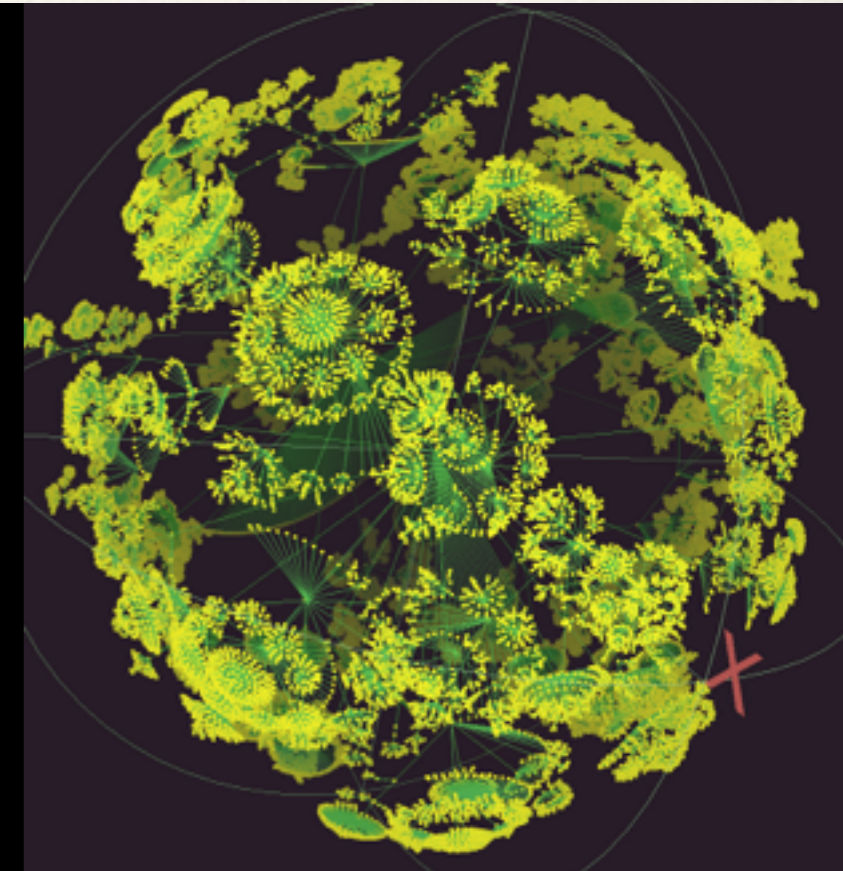
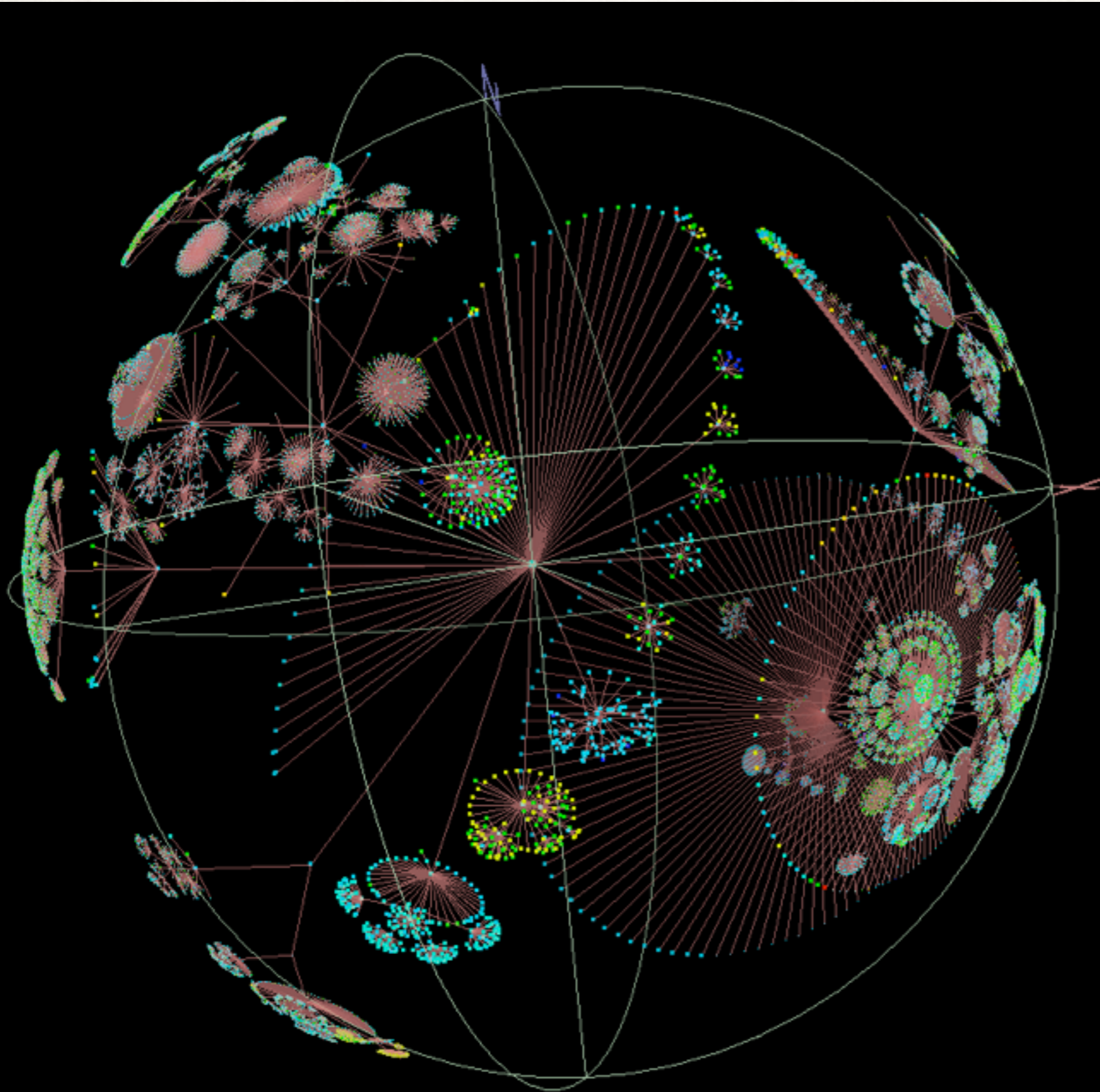
Hyperbolic browser

The tree is laid out in hyperbolic space and mapped back to the unit circle.

Can show 10x the number of nodes of a standard 2D approach (1000 vs. 100)

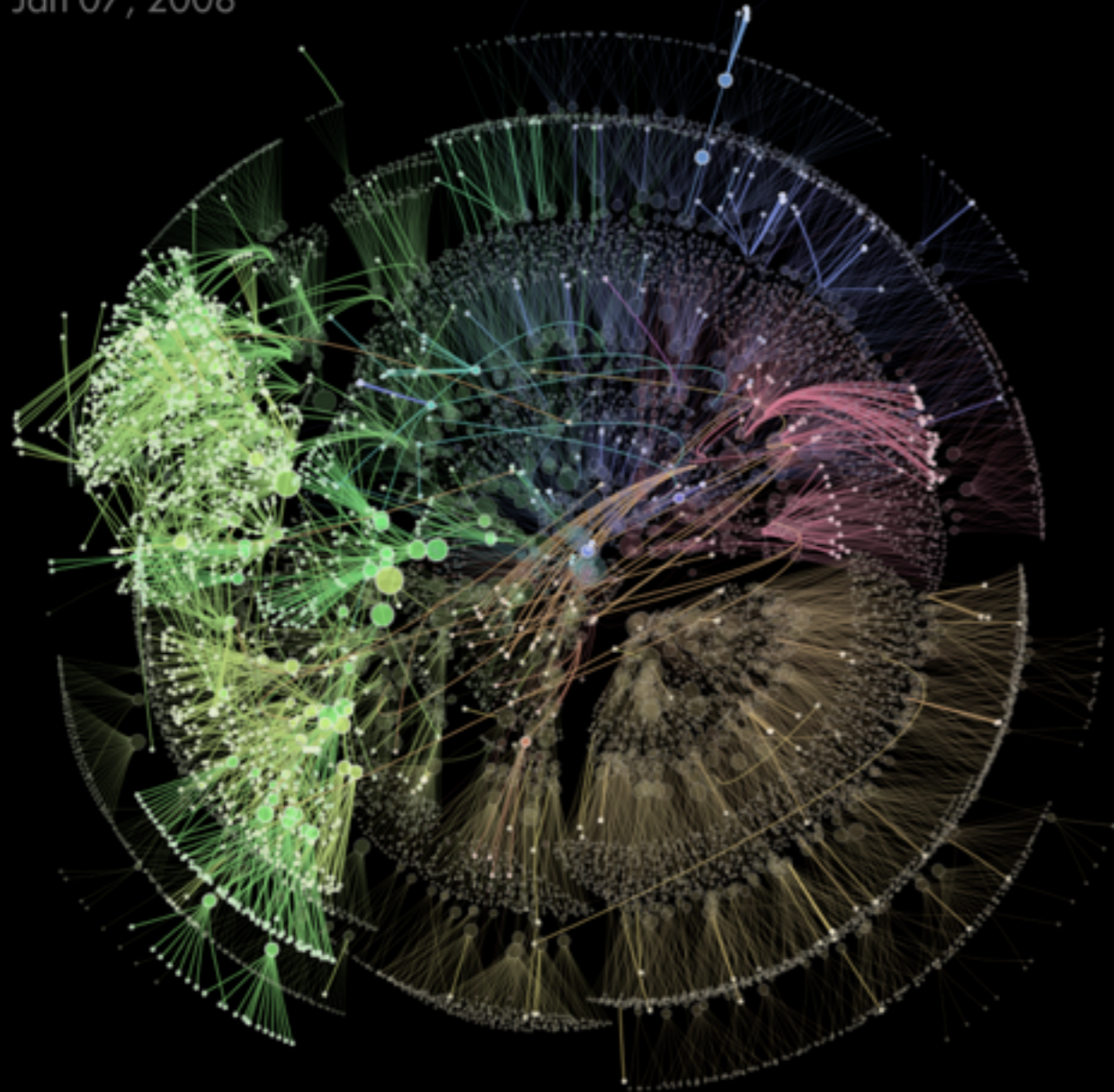


3D Hyperbolic Tree

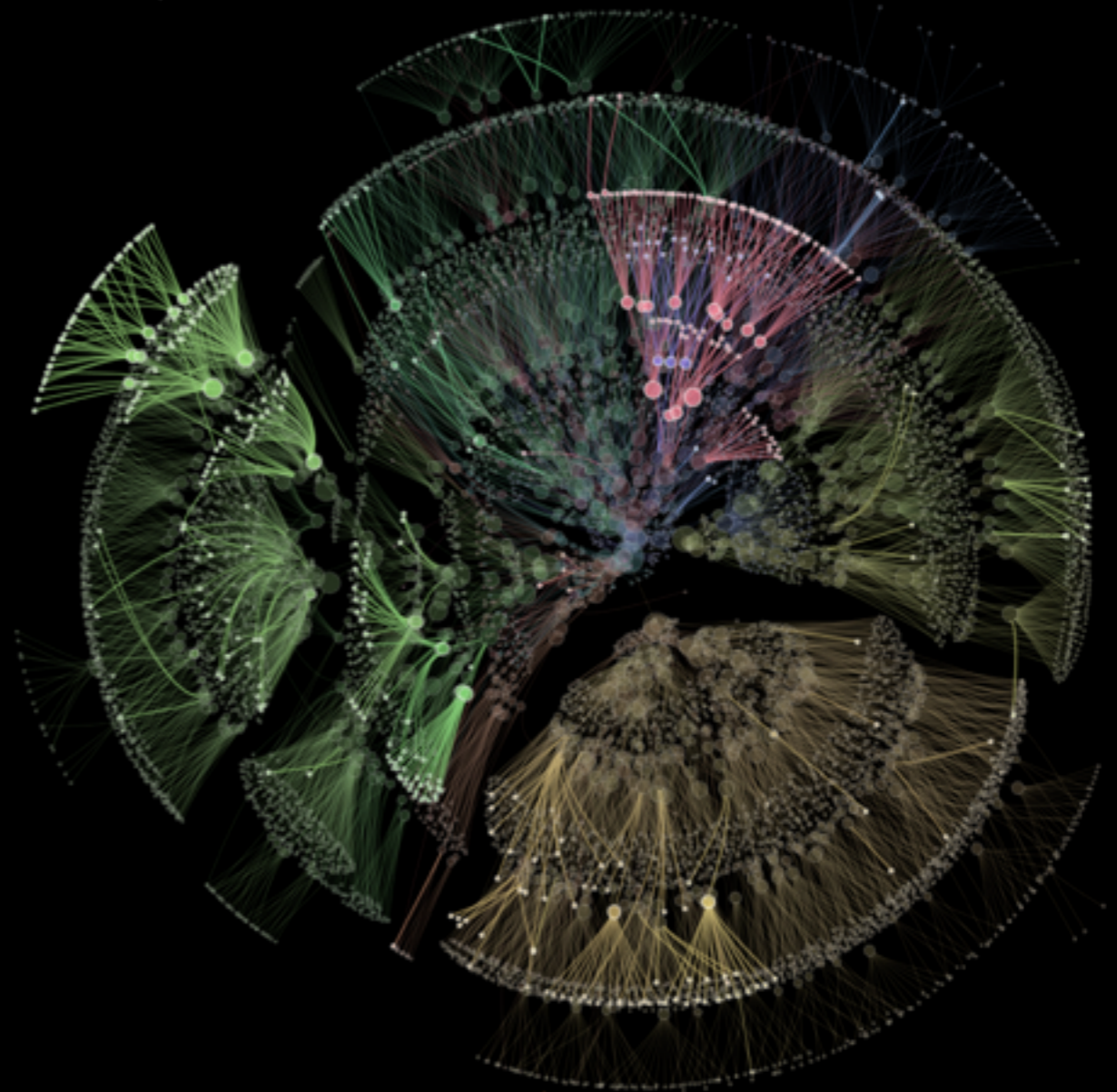


Force-directed radial layout

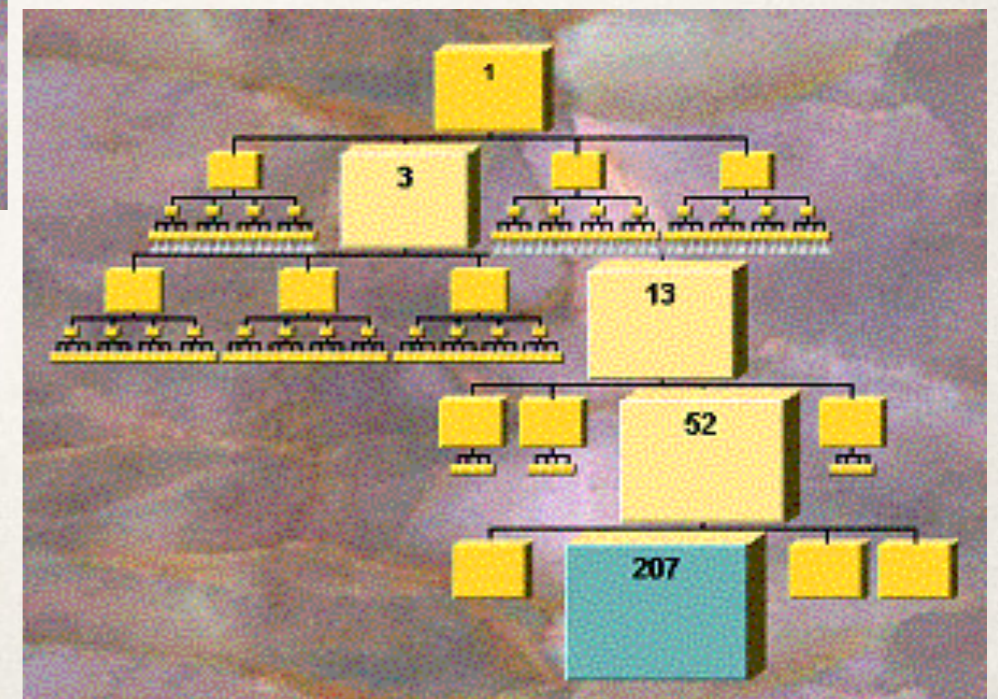
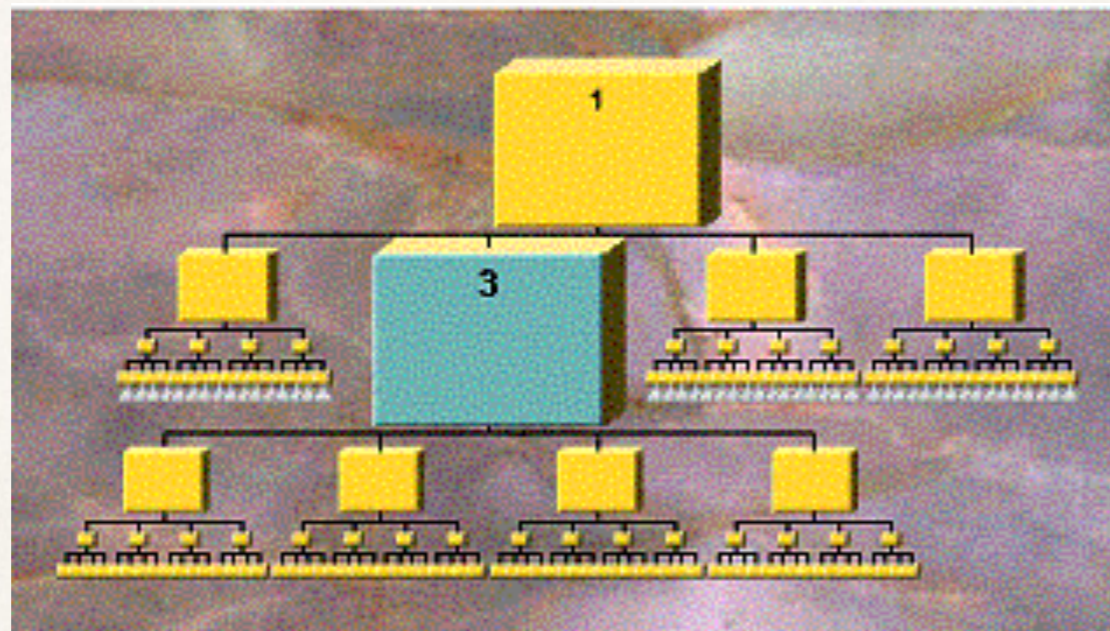
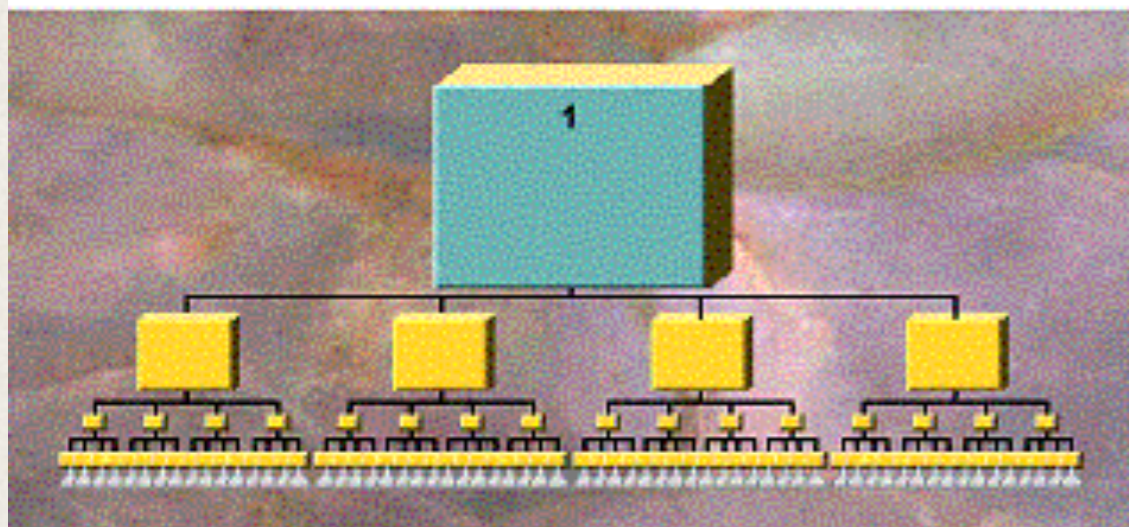
Jan 07, 2008



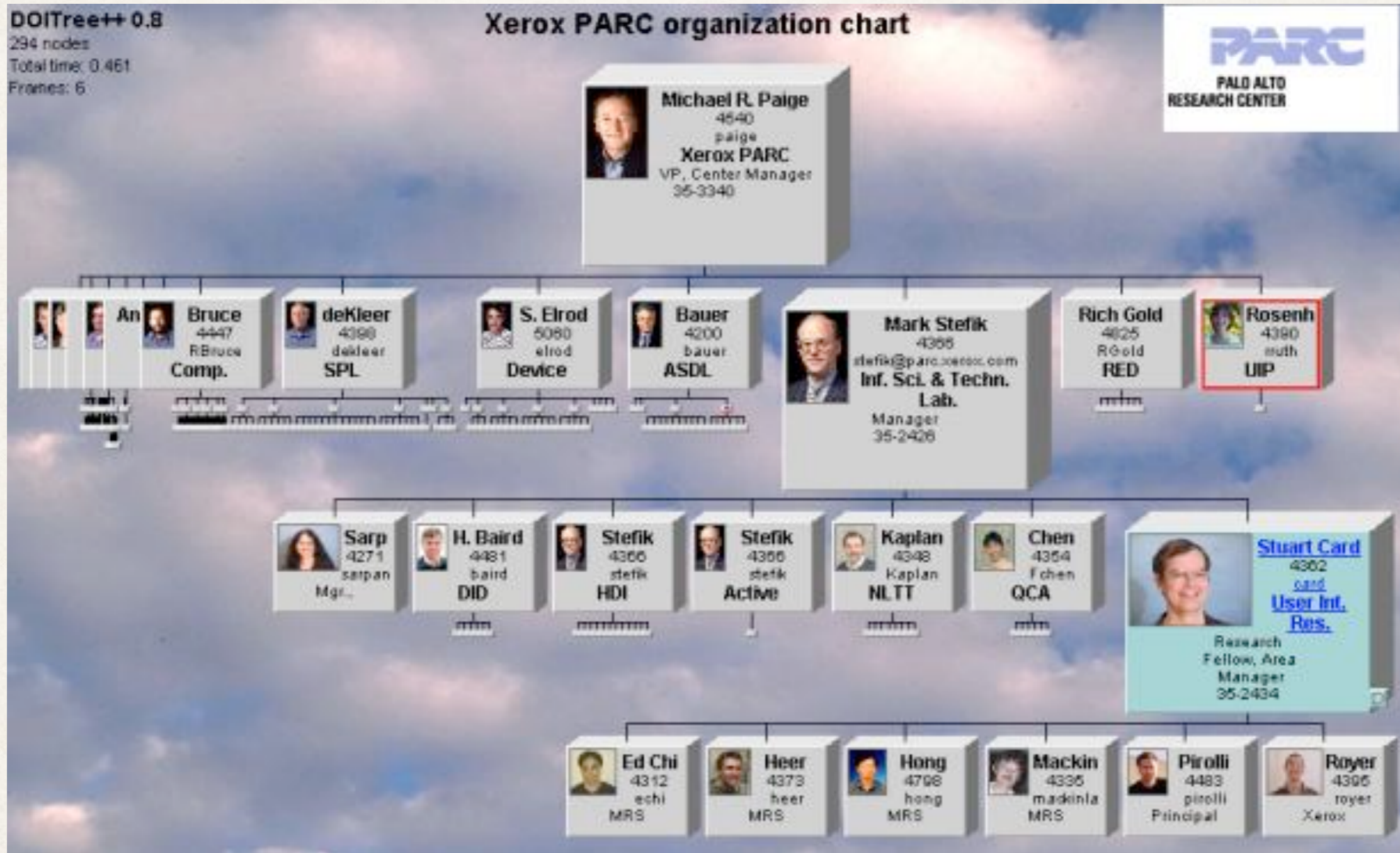
Mar 26, 2009



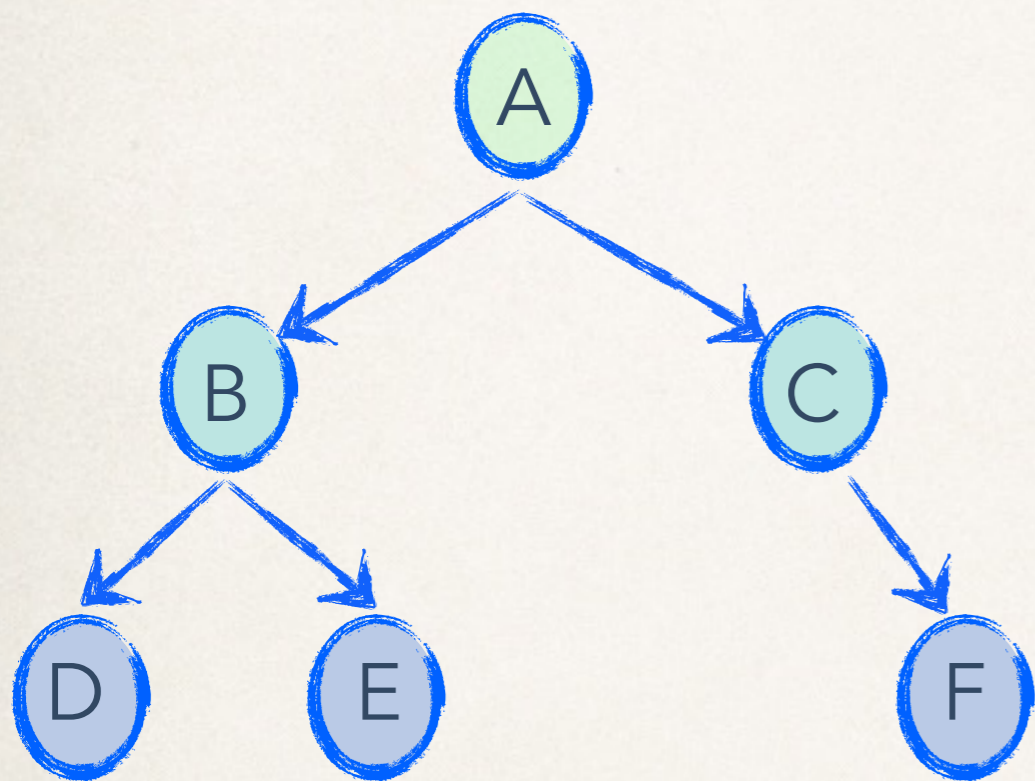
Degree-of-Interest (DOI) Trees



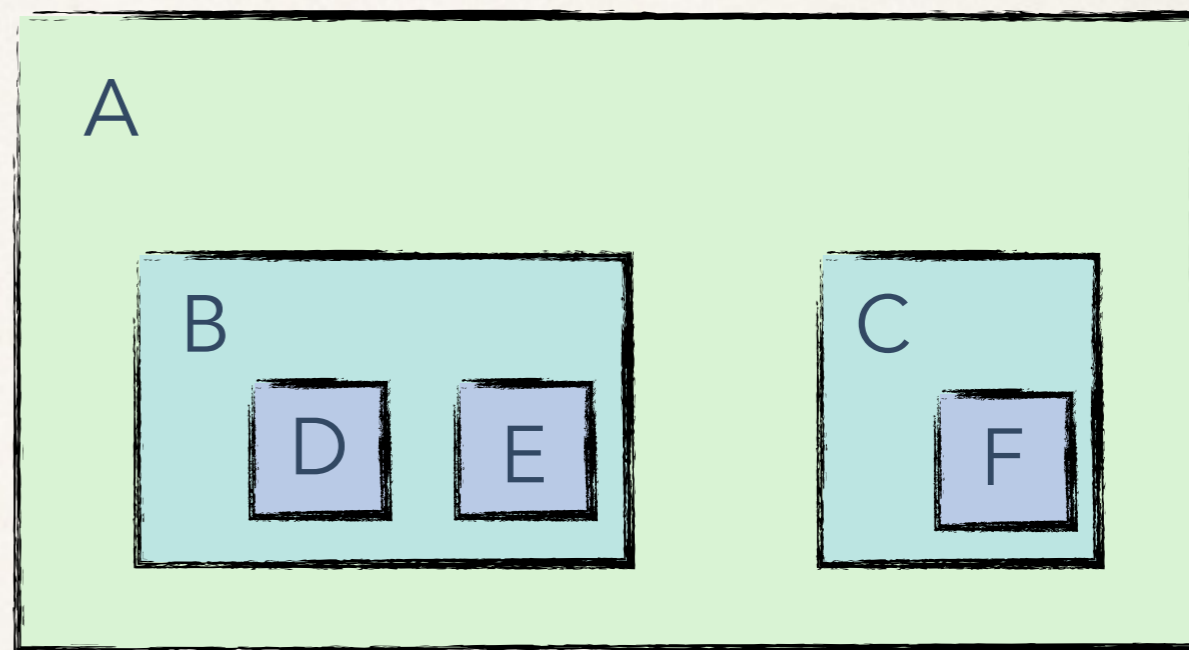
Degree-of-Interest Trees



Space filling trees



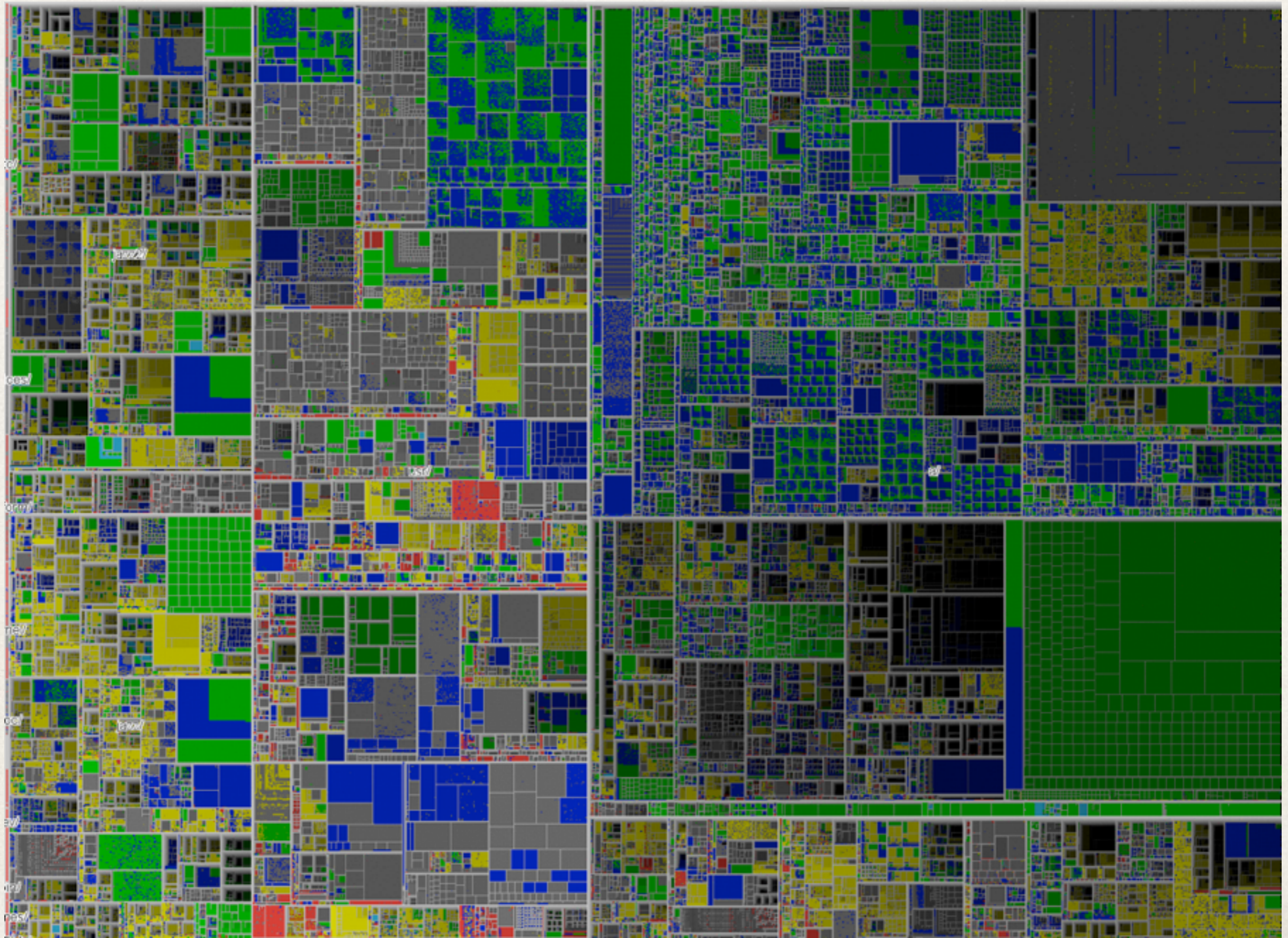
Connections



Containment

Treemaps

<http://www.cs.umd.edu/hcil/VisuMillion/>



Building a treemap

```
makeTreeMap(node, orientation)
  for each child of node
    if orientation is vertical
      create rectangle with width scaled as proper
      percentage of node
      if child has children
        makeTreeMap(child, horizontal)
    else
      create rectangle with height scaled as proper
      percentage of node
      if child has children
        makeTreeMap(child, vertical)
```


Treemaps

Example: Sales figures (\$M)

North America

United States (\$200)

Canada (\$200)

Europe

Germany (\$150)

Austria (\$100)

Russia (\$150)

Sweden (\$100)

Asia

S. Korea (\$50)

China (\$50)



Treemaps

Example: Sales figures (\$M)

North America (\$400)

United States (\$200)

Canada (\$200)

Europe (\$500)

Germany (\$150)

Austria (\$100)

Russia (\$150)

Sweden (\$100)

Asia (\$100)

S. Korea (\$50)

China (\$50)



Treemaps

Example: Sales figures (\$M)

North America (\$400)

United States (\$200)

Canada (\$200)

Europe (\$500)

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Austria (\$100)

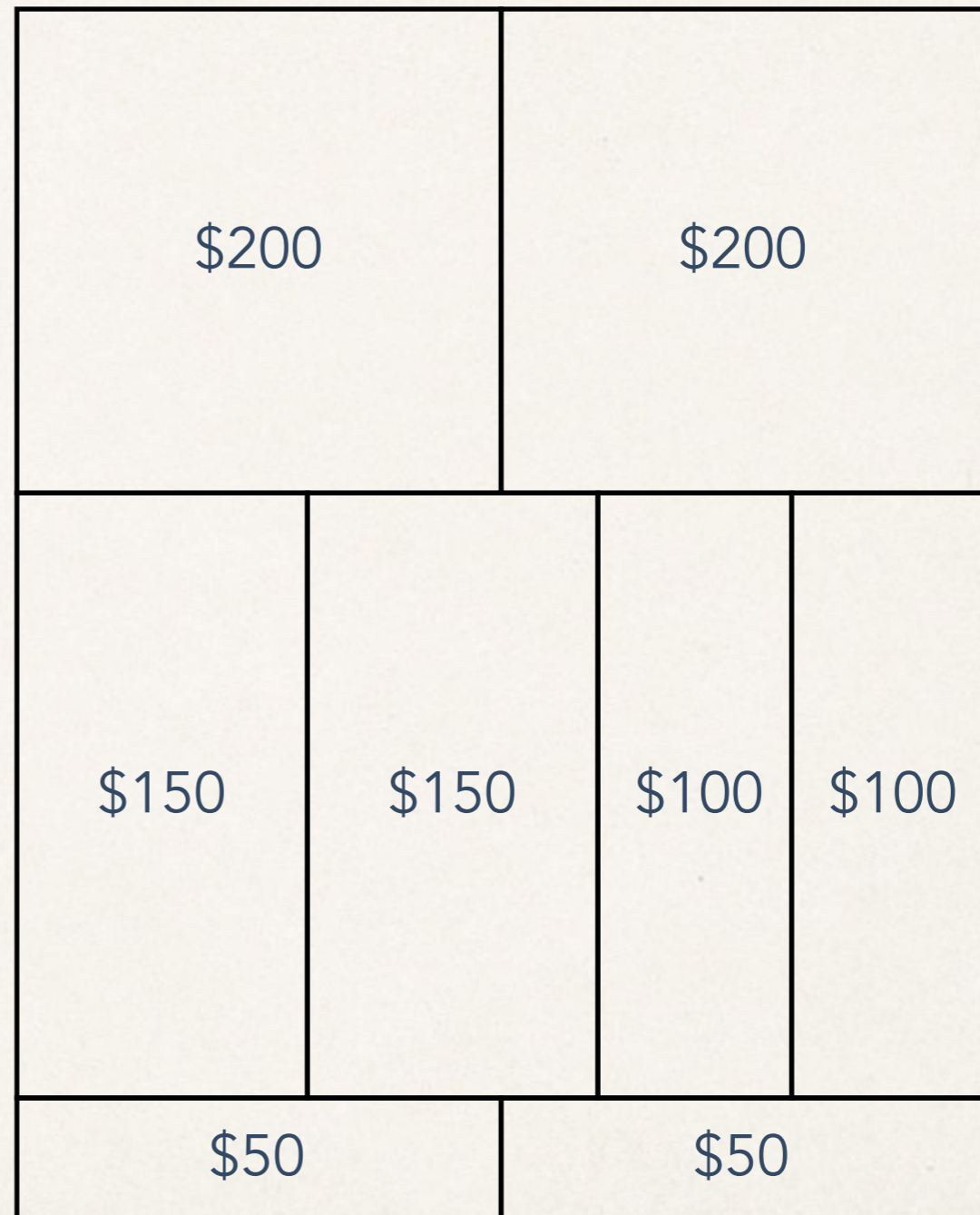
Russia (\$150)

Sweden (\$100)

Asia (\$100)

S. Korea (\$50)

China (\$50)



Treemaps

Example: Sales figures (\$M)

North America (\$400)

United States (\$200)

Canada (\$200)

Europe (\$500)

Germany (\$150)

Austria (\$100)

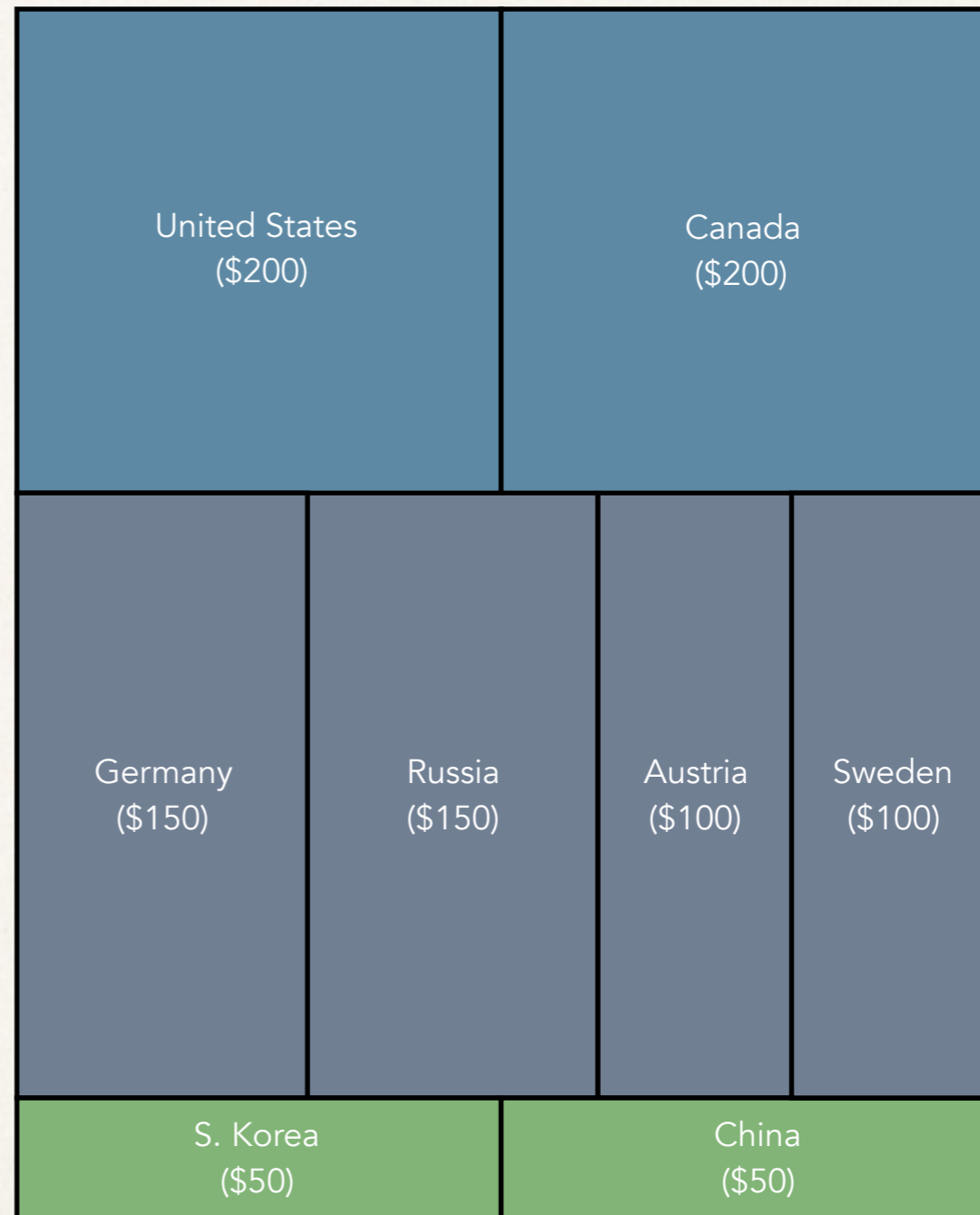
Russia (\$150)

Sweden (\$100)

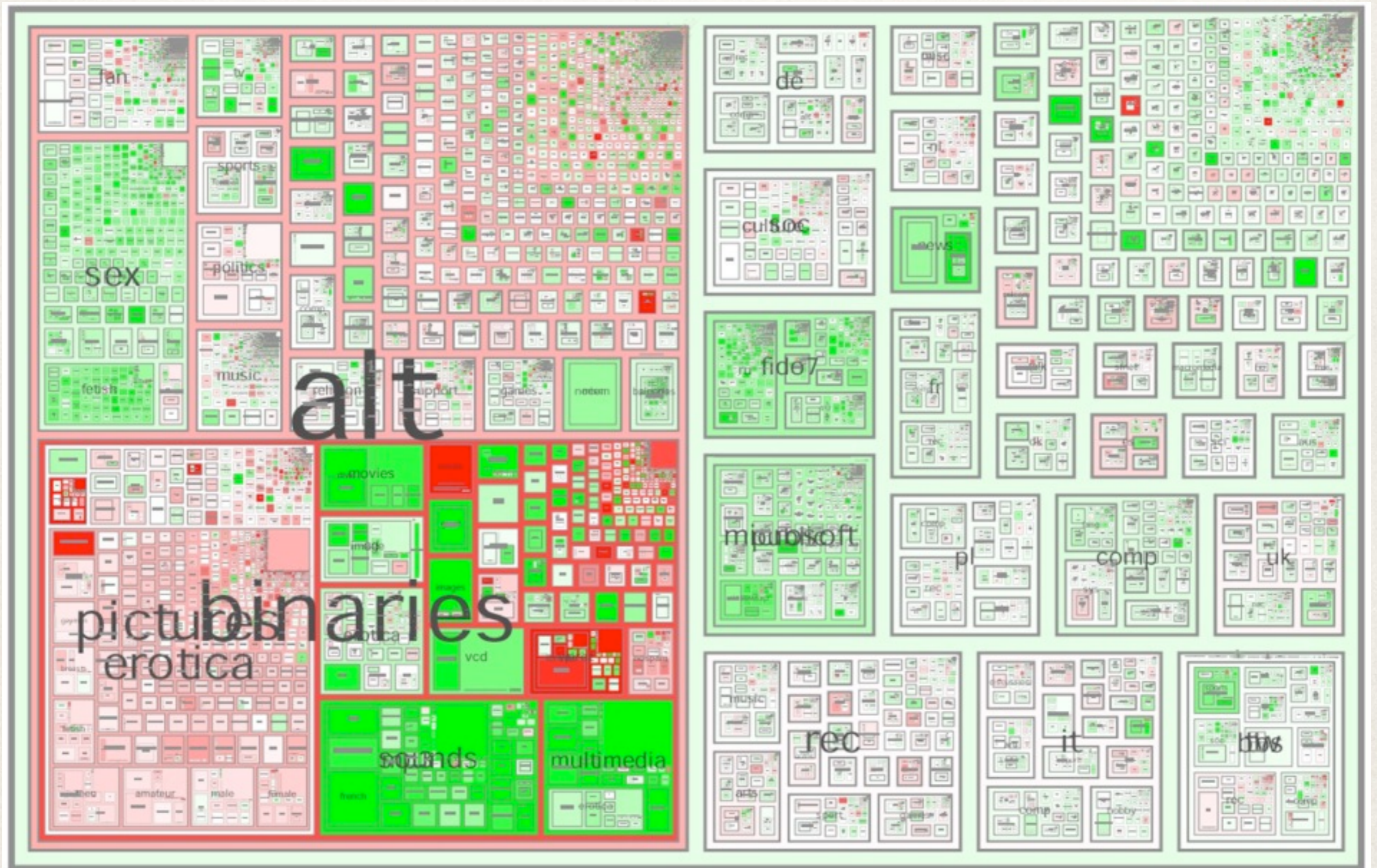
Asia (\$100)

S. Korea (\$50)

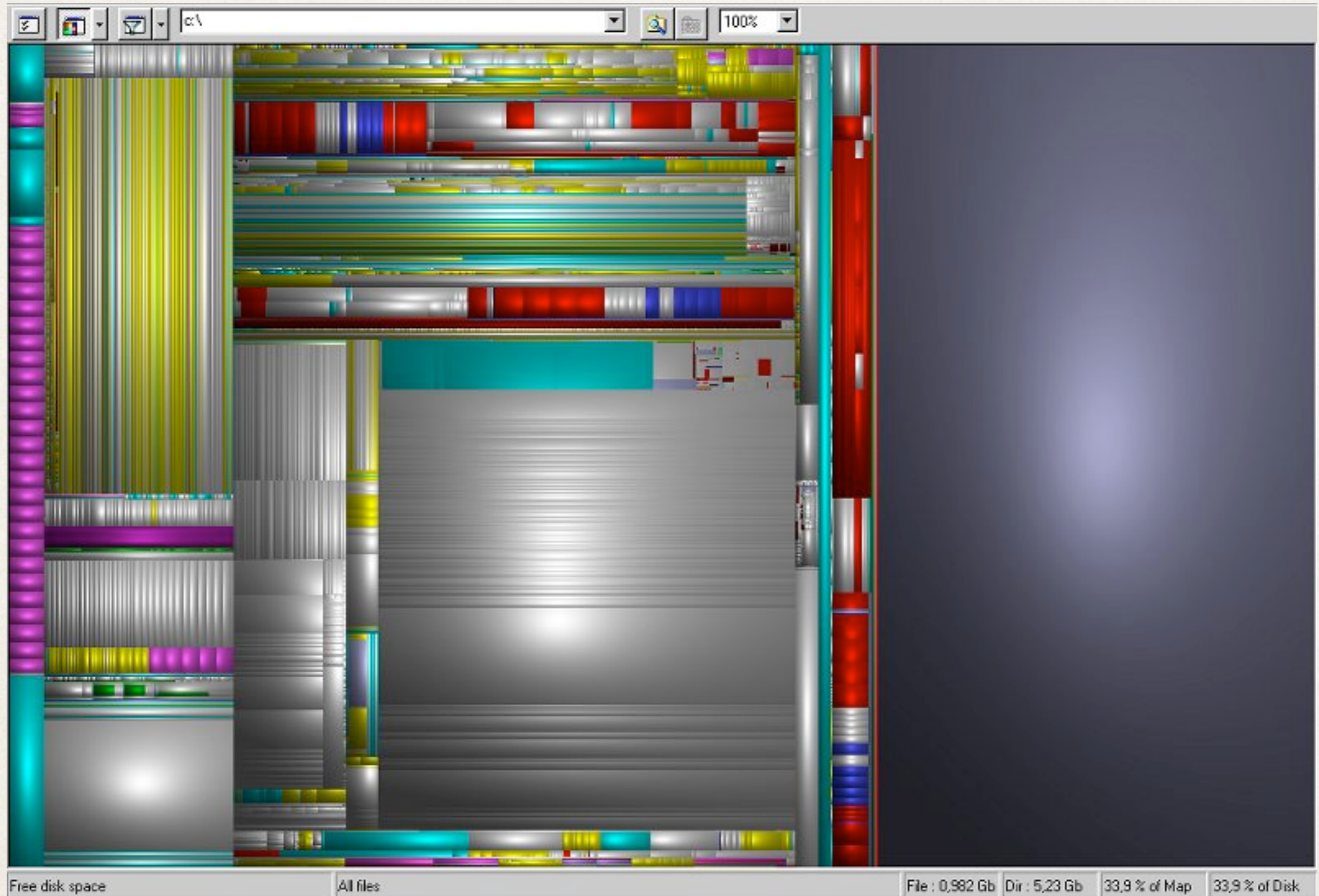
China (\$50)



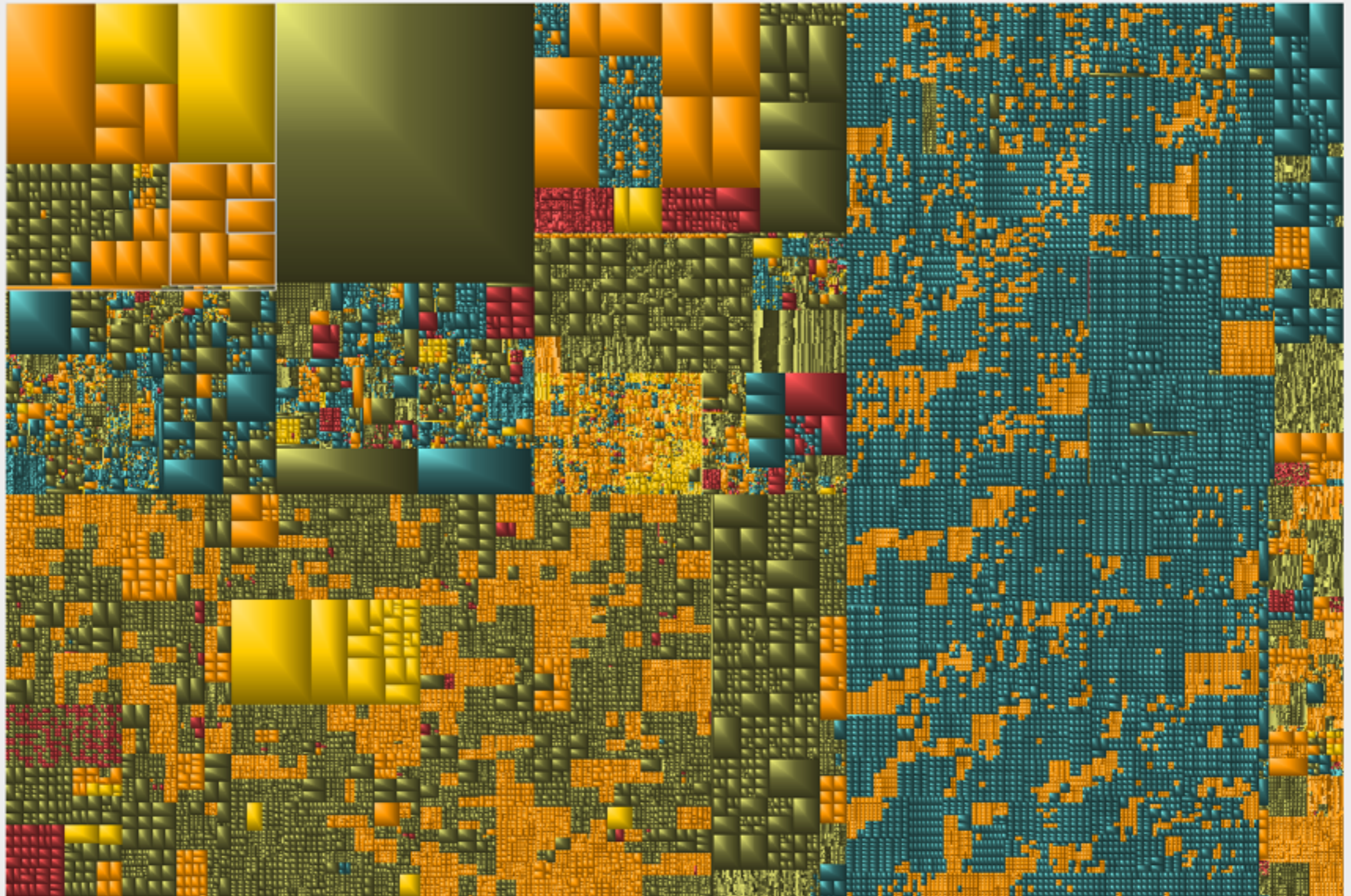
Nested treemap



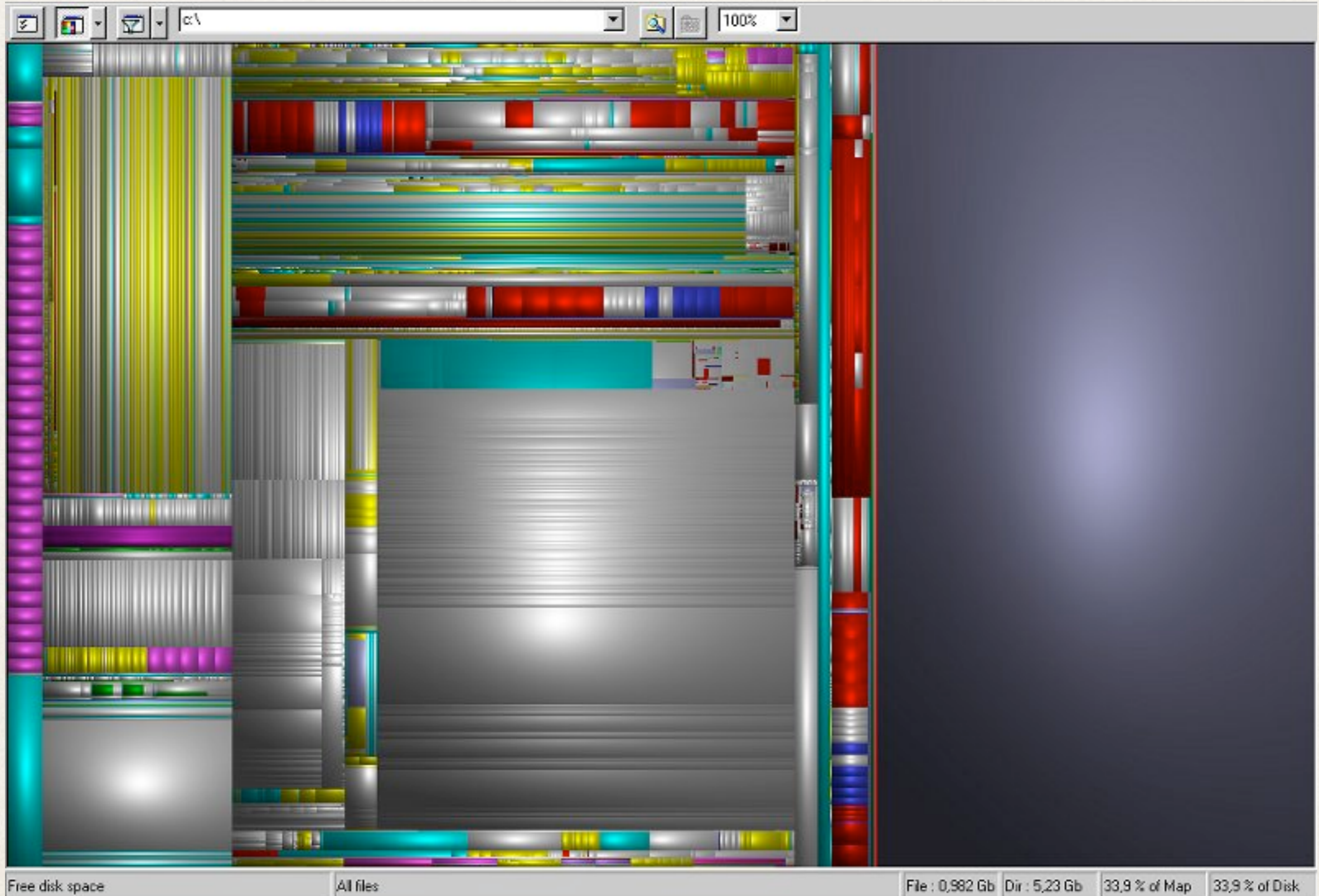
Cushion treemaps



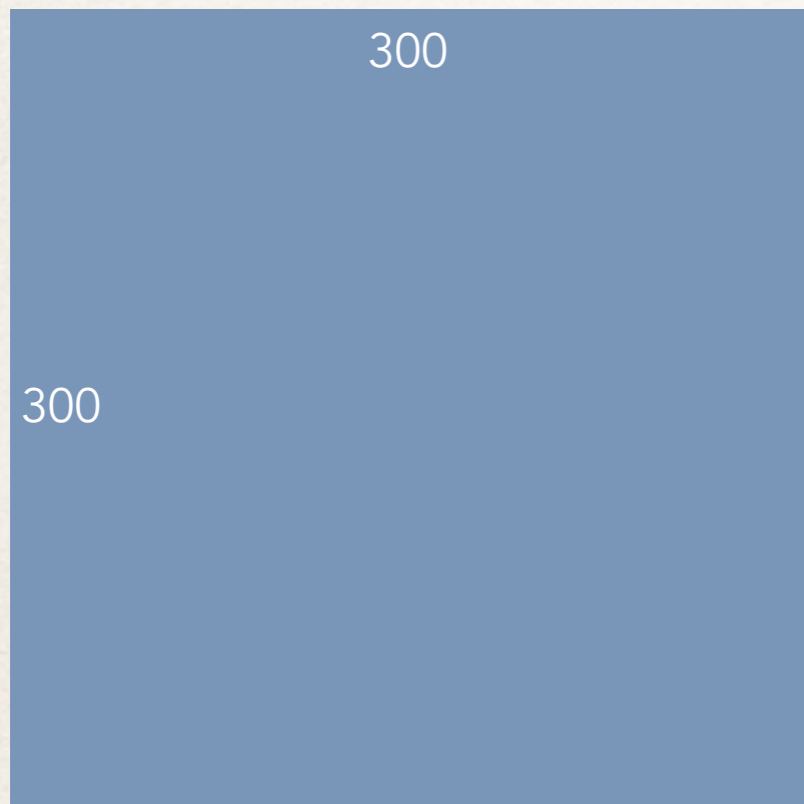
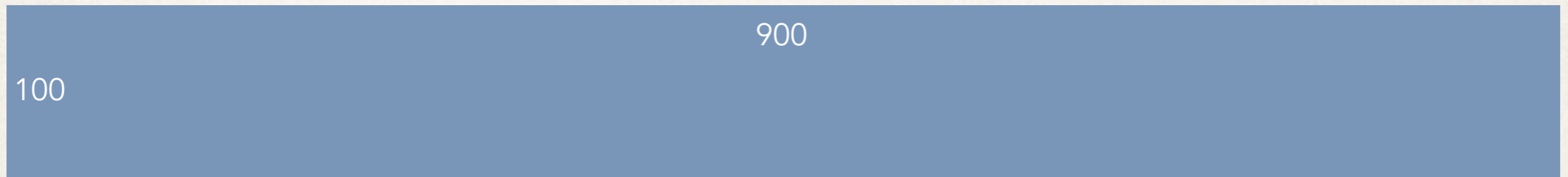
Not a cushion treemap



The aspect ratio problem...

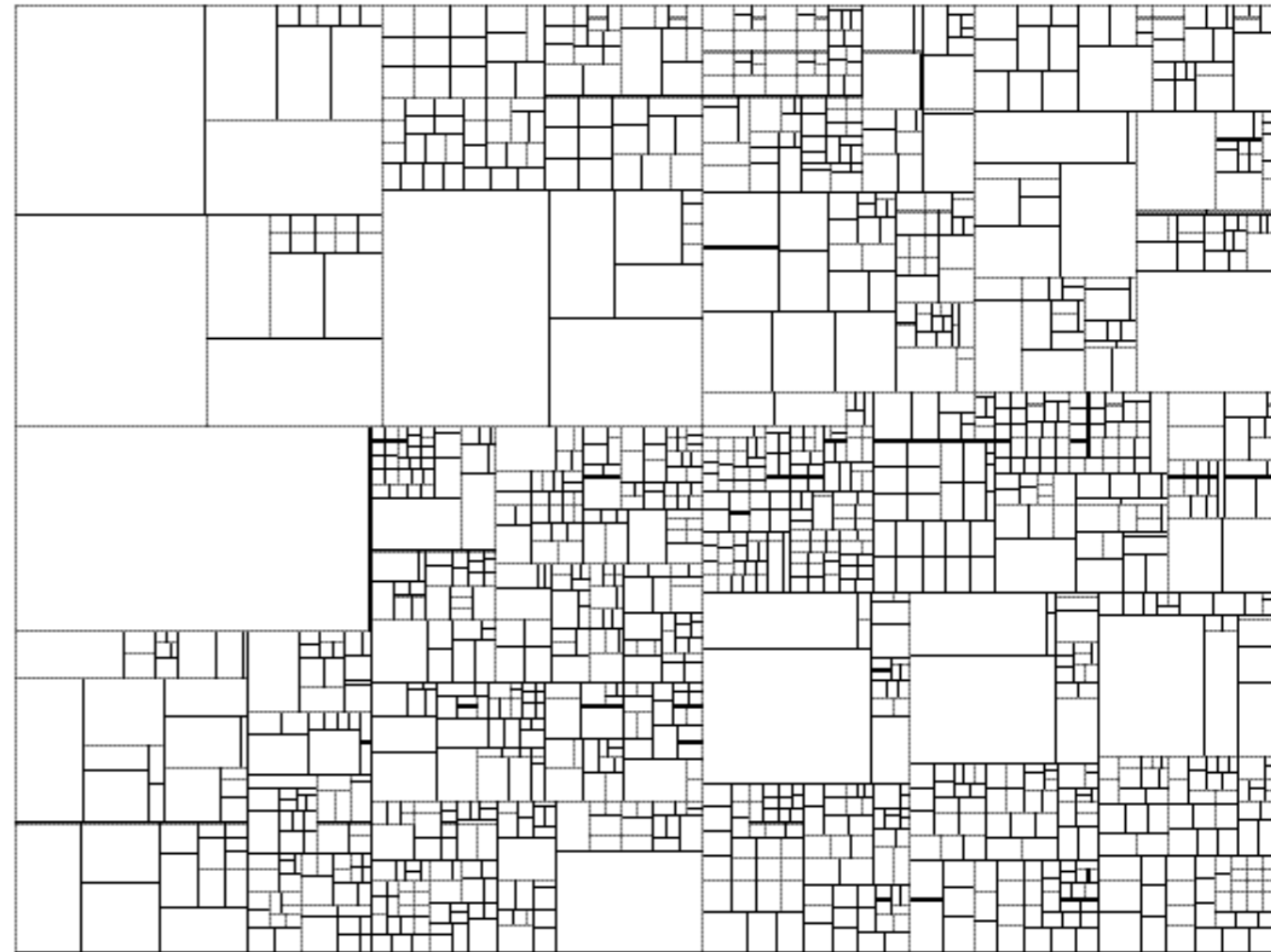
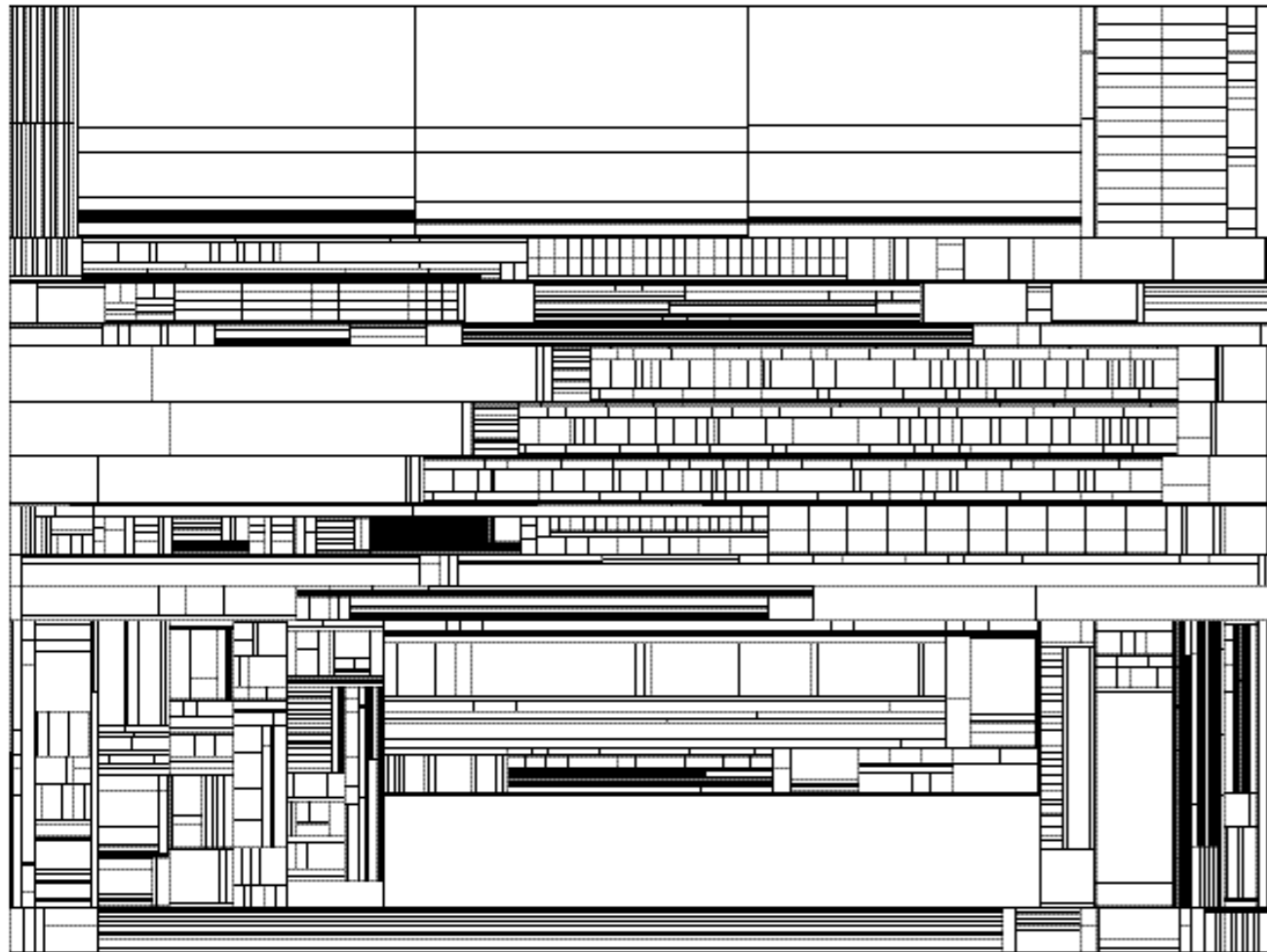


The aspect ratio problem...

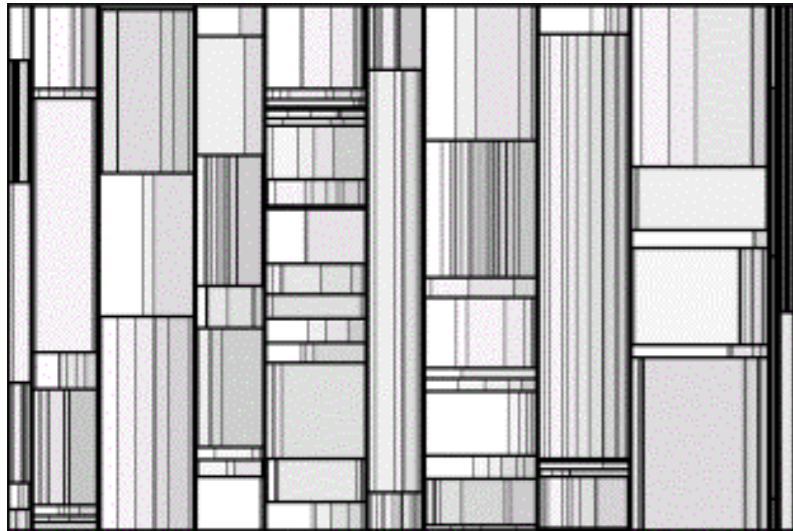


Which one is bigger?
Trick Question!

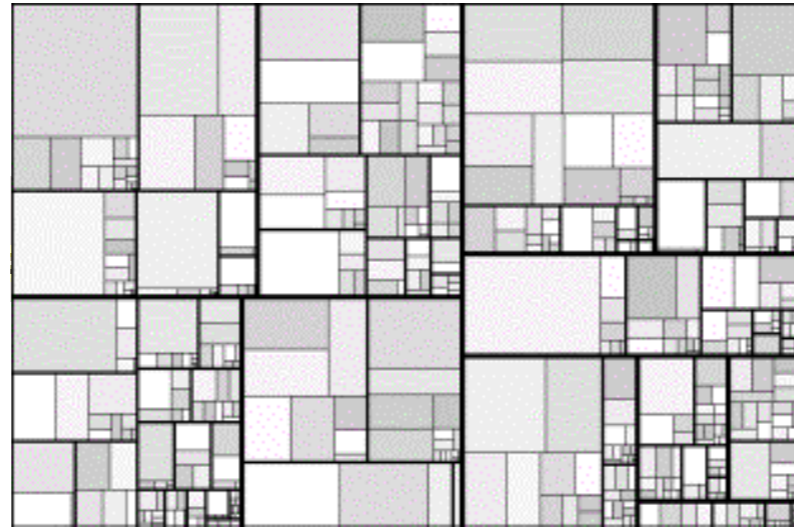
Squarified treemaps



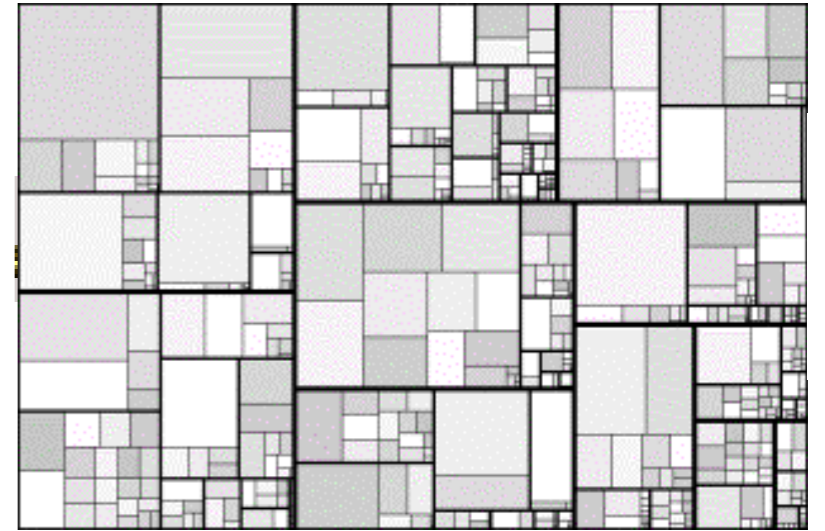
Even more approaches...



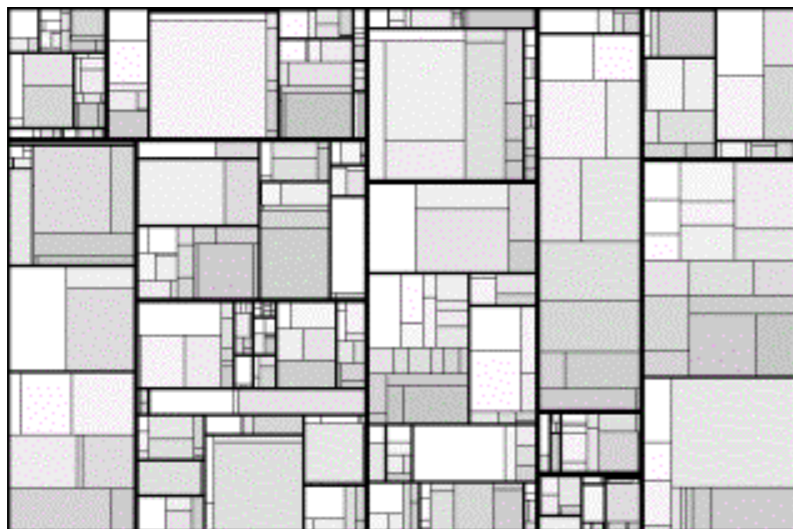
Slice-and-dice



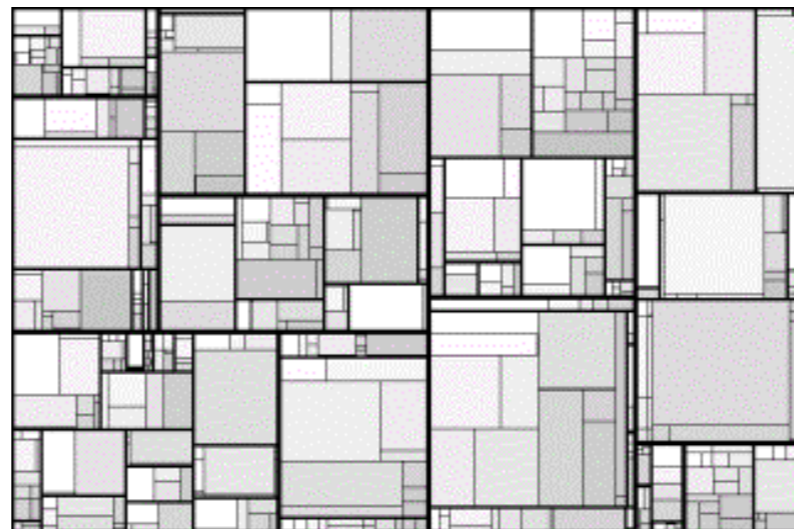
Cluster



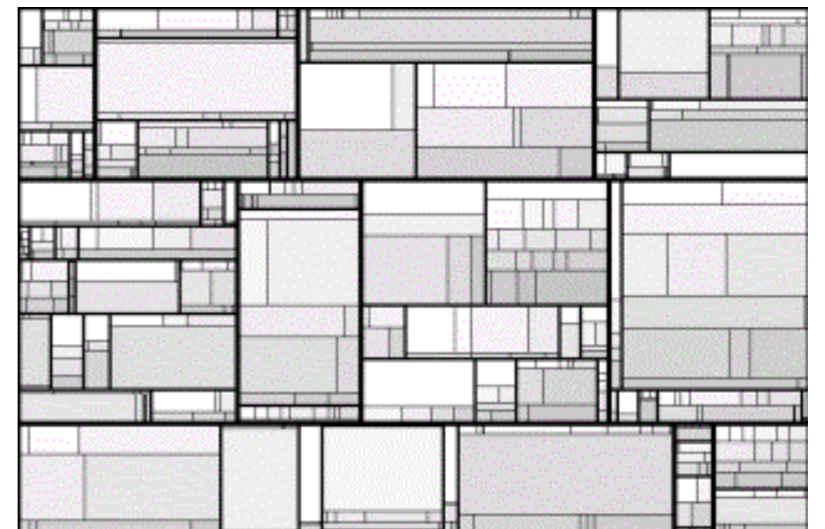
Squarified



Pivot-by-middle

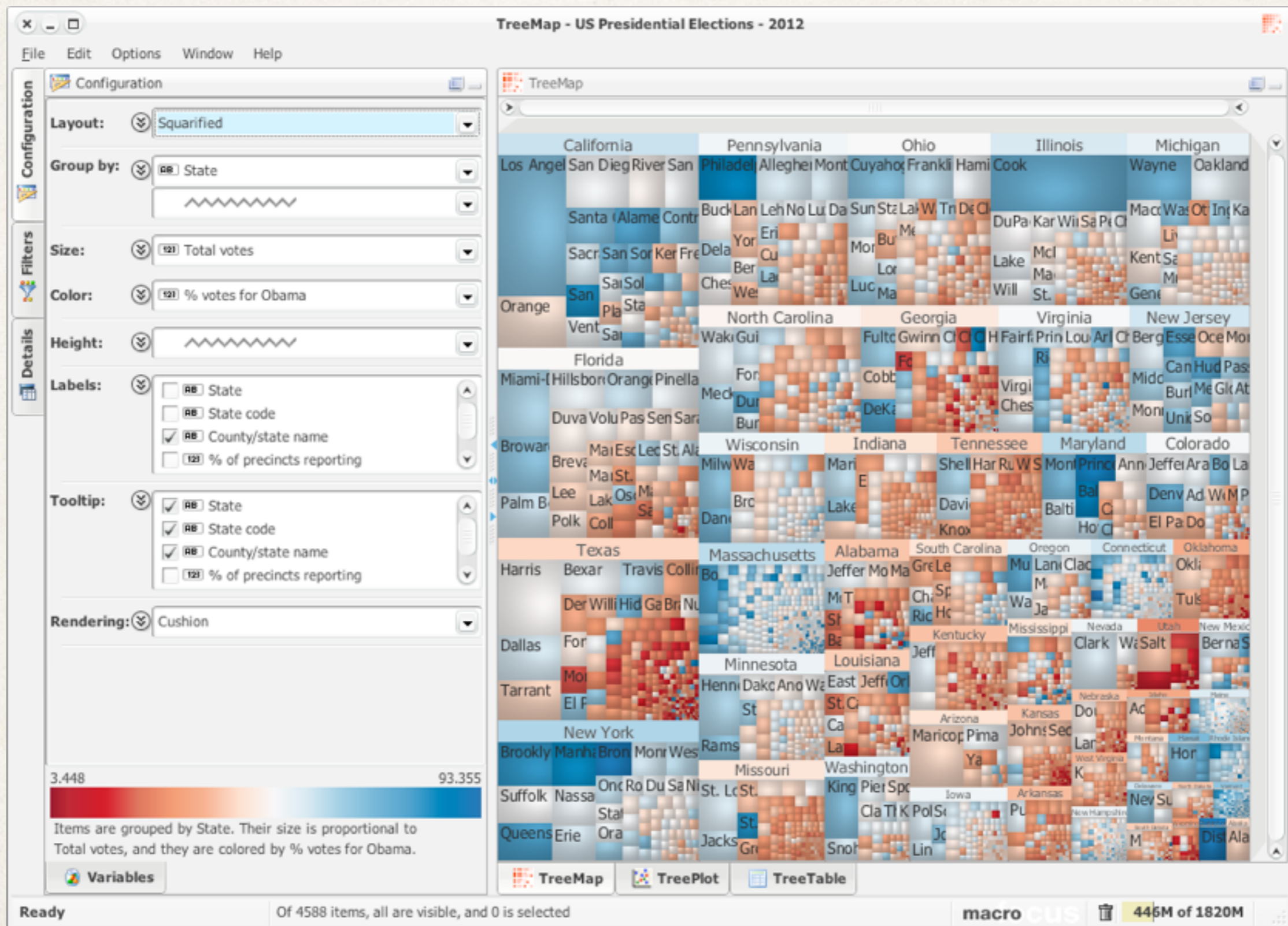


Pivot-by-size

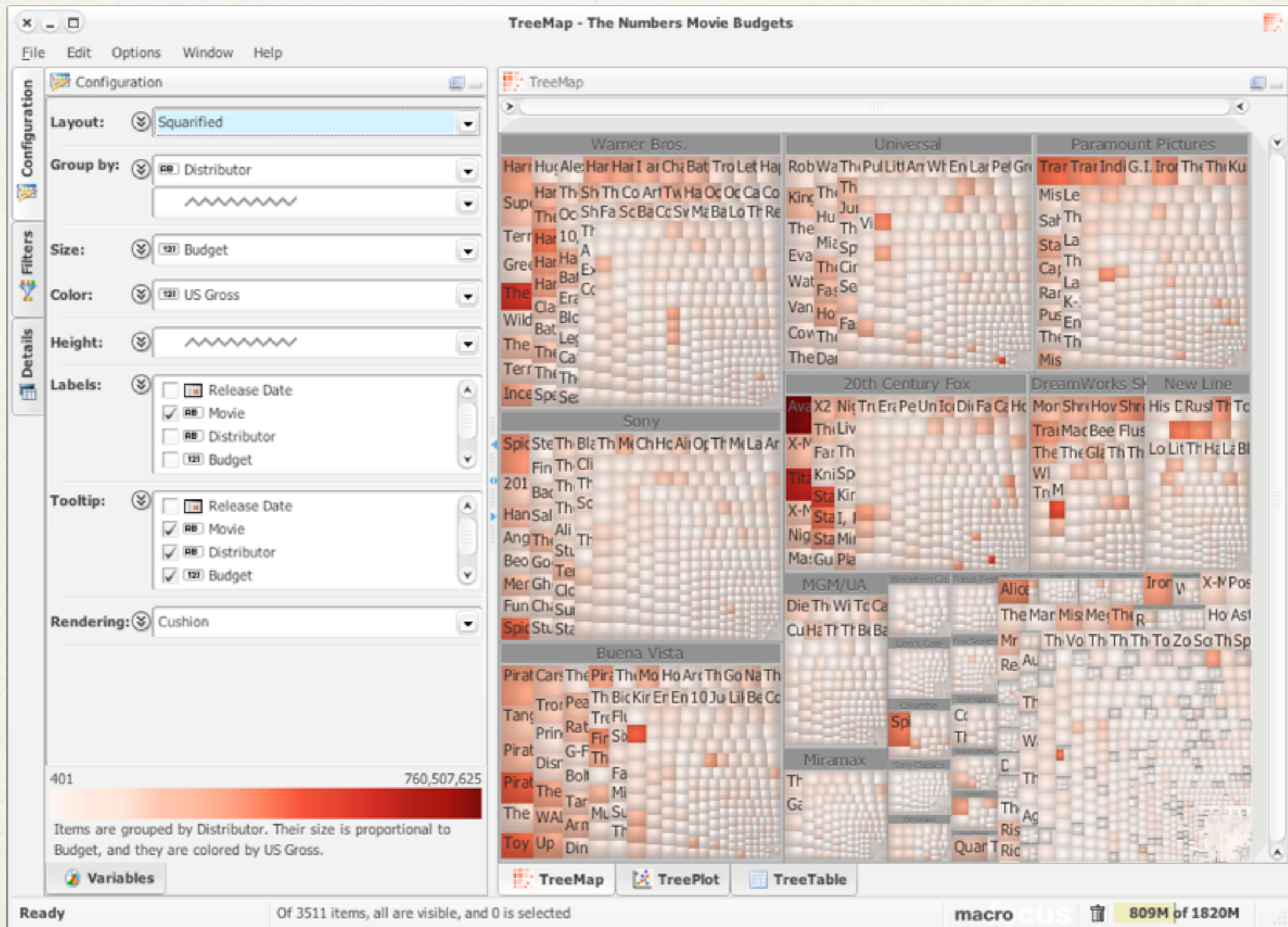


Strip

Example: Presidential election 2012



Example: Movie budgets



Example: News stories

http://newsmap.jp

Liverpool Edges Manchester City and Edges Toward Premier League Title

Spieth, 20, joins Watson atop Masters leaderboard

NASCAR: Harvick wins Sprint Cup race at Darlington in overtime

Jordan Spieth joins Bubba Watson on top at Masters

Sunday Notes: Ryan Zimmerman Out 4-6 Weeks

Rays place right-hander Alex Cobb on DL

Ryan Smyth sent out in style as Oilers beat Canucks 5-2

Lightning LW Ryan Malone busted for DUI, cocaine possession

Anatomy of a 9-2 record: Why the Brewers have baseball's best record

Comet claims Katowice Open title

Knicks officially eliminated from playoffs

Premier League: Swansea boss Gary Monk unhappy after Chico Flores' red card

Gray Stymies Seattle in Oakland's 3-1 Win

Five Cuts: Nats lose Zimmerman to broken thumb, divergent fortunes in the NL...

Dale Earnhardt Jr. doesn't want to hear how he almost won

Harden back Focals near Pelicans 111-104

Preview: Ducks at Kings

Falcons' regular starters to play vs. the eagles

Ukraine Launches 'Anti-Terrorist' Operation in Slovyansk

William returns to Christchurch with Kate

Kate Middleton Sips Wine in New Zealand, Quashing Pregnancy Rumors

FWC investigating bear attack near Orlando

Bigger, more rarefied Coachella offers revelers creature comforts

Plane Searchers Expand Visual Hunt as Black Boxes Remain Silent

'This would never have happened pre-Diana'

No brother or sister for Prince George - yet

IPCC report: Climate needs swift shift to clean energy

Last minute tax tips as April 15 deadline nears

Marilyn Monroe Earnings Auctioned for \$185000

AP PHOTOS: Vatican, Holy Land mark Palm Sunday

Can Duchess Kate be pregnant if she's sipping wine?

Missing Plane's Black Box Batteries May Have Died

A Guide Through the Complexities of 401(k) Fees

Graceland issues more bonds: alternate success

Chance Of EG Audit Is The Lowest In Years

Mark Cuban swears Lauren Hill but younger brother Aaron doesn't make it

Bob Dylan Wins Saturday Night Live: All the Highlights

WSTN: Jay Z and Beyonce Make Surprise Appearances at Coachella

Clutching palms, olive branches, faithful join pope at Holy Week's start in St...

36 killed in insurgent attacks across Iraq

Flight 370 search continues as black box pings fade

Funeral held for Florida soldier killed at Fort Hood

Ukraine to launch anti-terror operation

Rand Paul: US 'can't imitate the whole world'

Black Bear Mauls Florida Woman, Deeps Her Out of Gorge

Web Novel Best Space Stories of the Week - April 13, 2014

Cherry trees bloom six years early after a trip to space

Abdullah Leads Ghani in Afghan Presidential Poll Partial Results

Opposition PD-Ps deal with last term party clears way for Jokowi governor ...

Dear Pakistan prosecutor, known as 'pabak' makes his mark

Fire destroys 500 homes in Volgograd

Supreme Court ruling sets off race for bigger donations

Neighbors: Man Killed by Police After Hit Dropping Gun Was Here at Hearing

Andrew Sullivan sparks fire of gay conservatism over defense of former Scalia ...

Princeton's a bit blab on same day as father's

US Government Will Detail Internet

HTC One (M5) vs. Samsung Galaxy S4

Bird flu detected in Japan

Stack up on Issues: Possible

newsmap

SELECT ALL

WORLD

NATIONAL

BUSINESS

TECHNOLOGY

SPORTS

ENTERTAINMENT

HEALTH

LESS THAN 10 MIN. AGO

Sun April 13, 2014 15:57:35

NEWSMAP IS ©2004-2010 MARDOS MESKAMP | CONTACT | BLOG | ABOUT

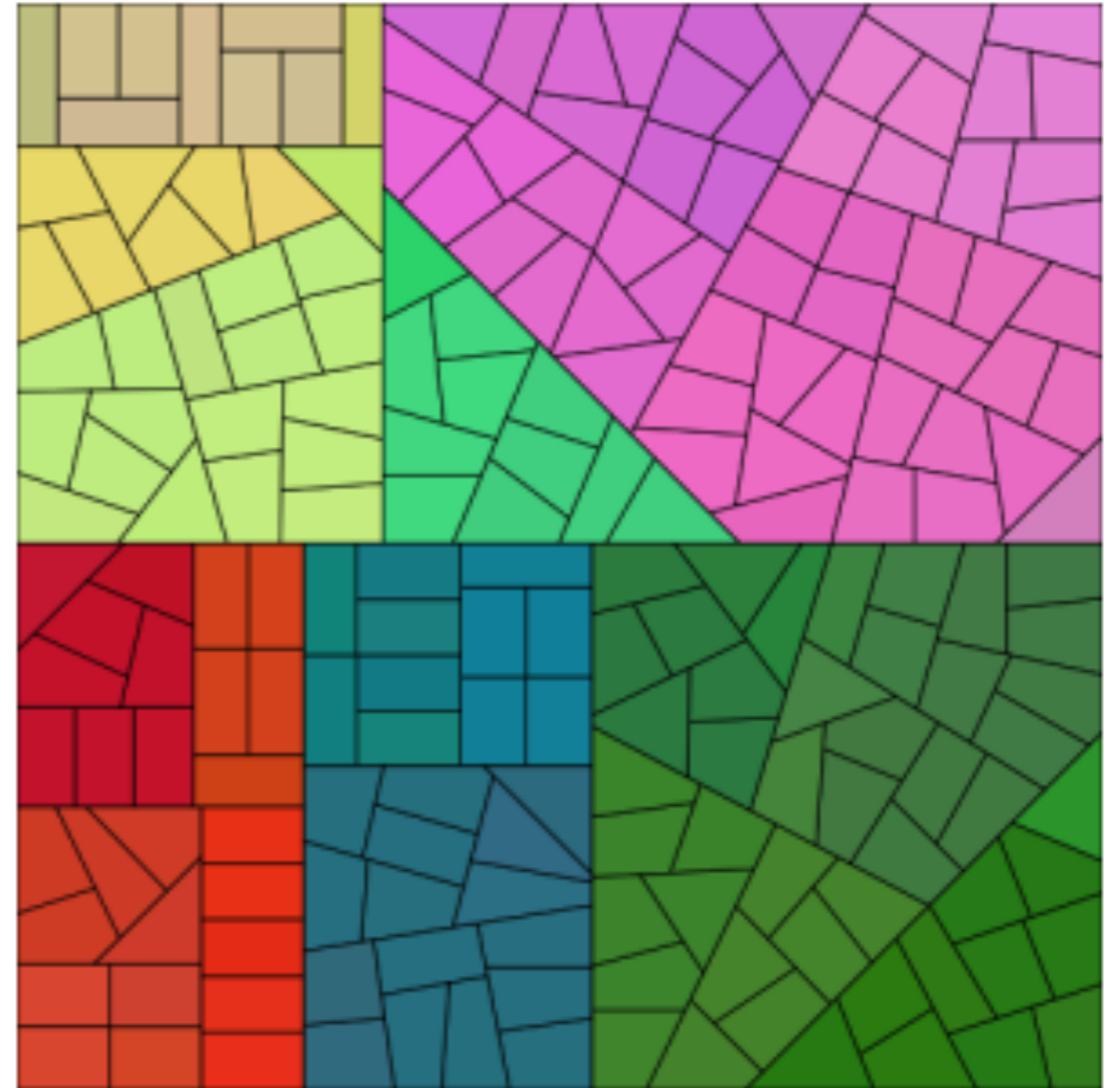
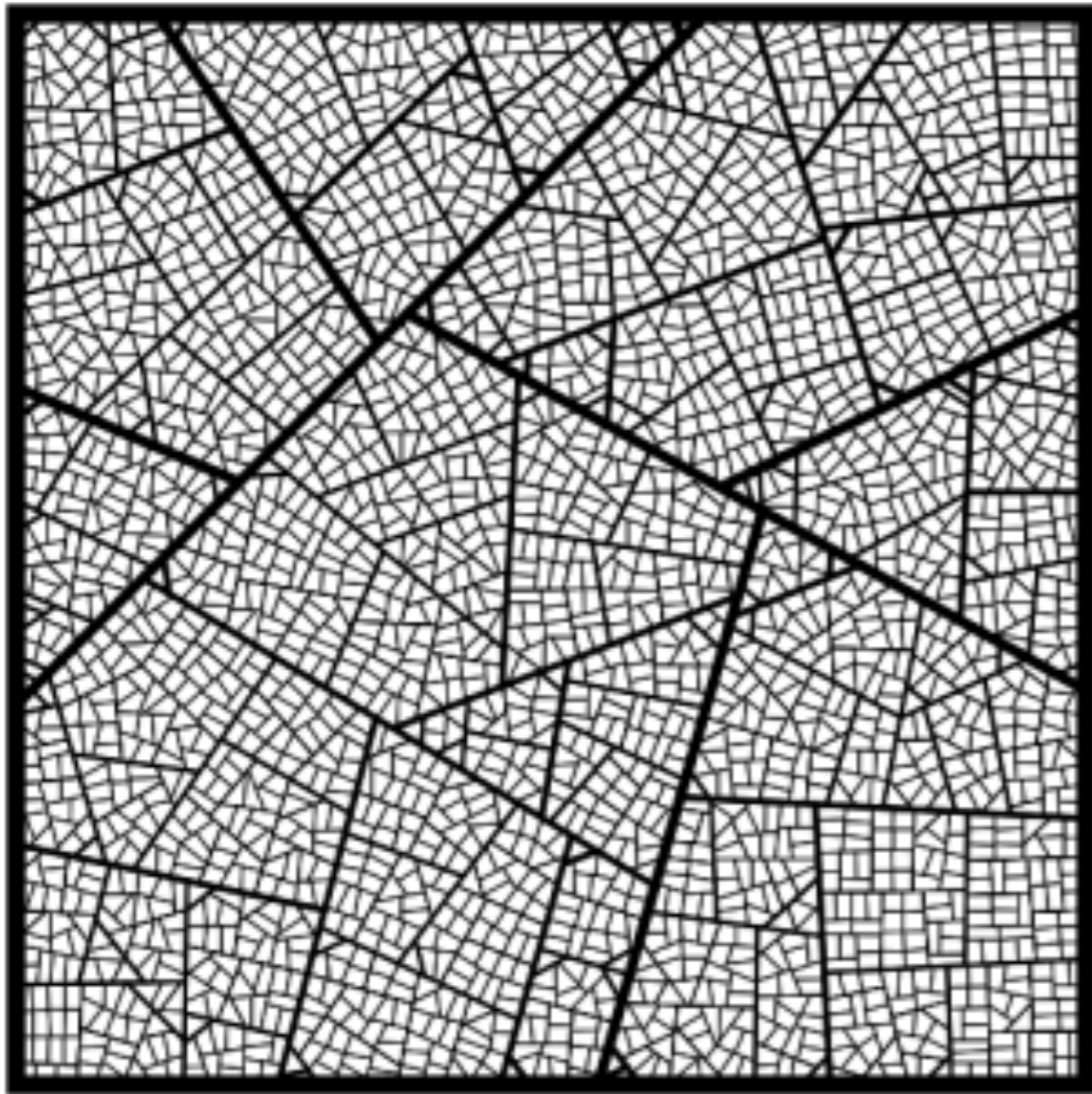
powered by Google

hosting by huteml

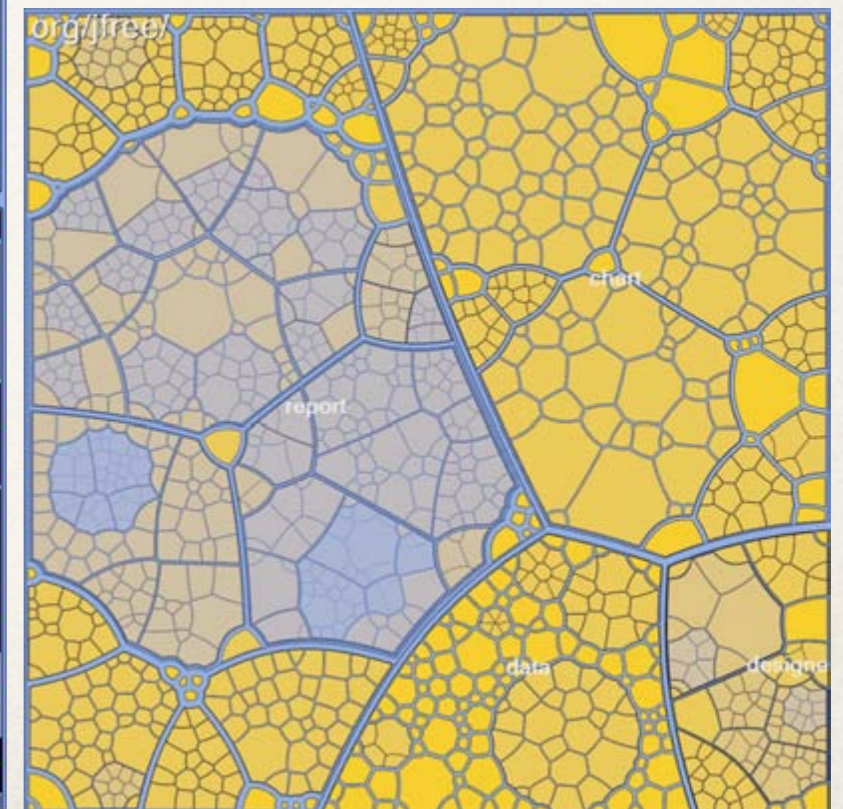
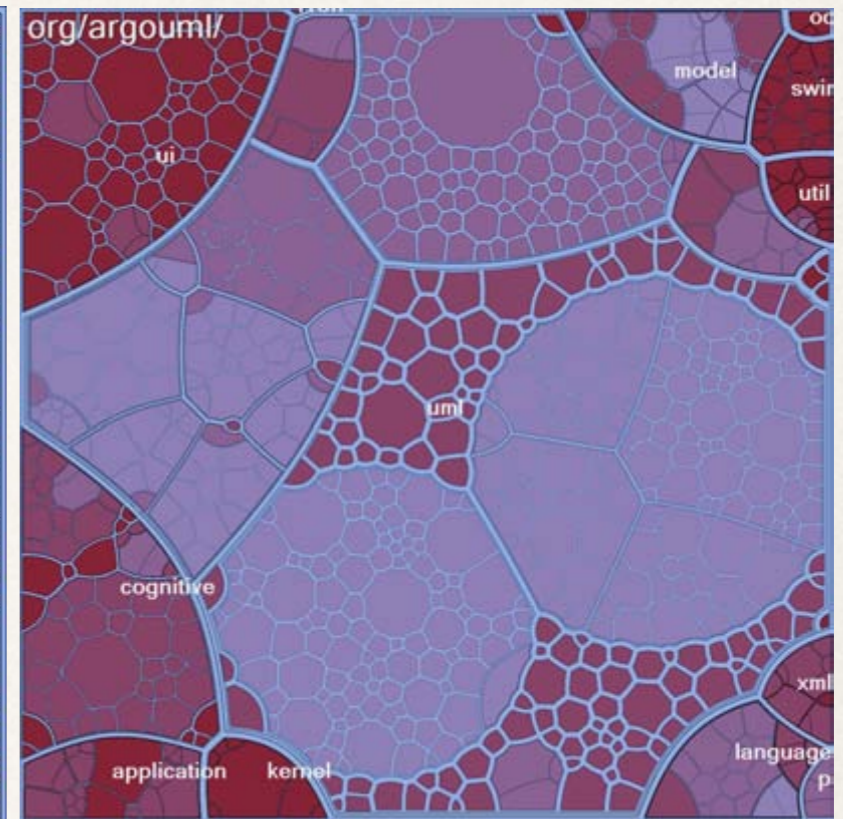
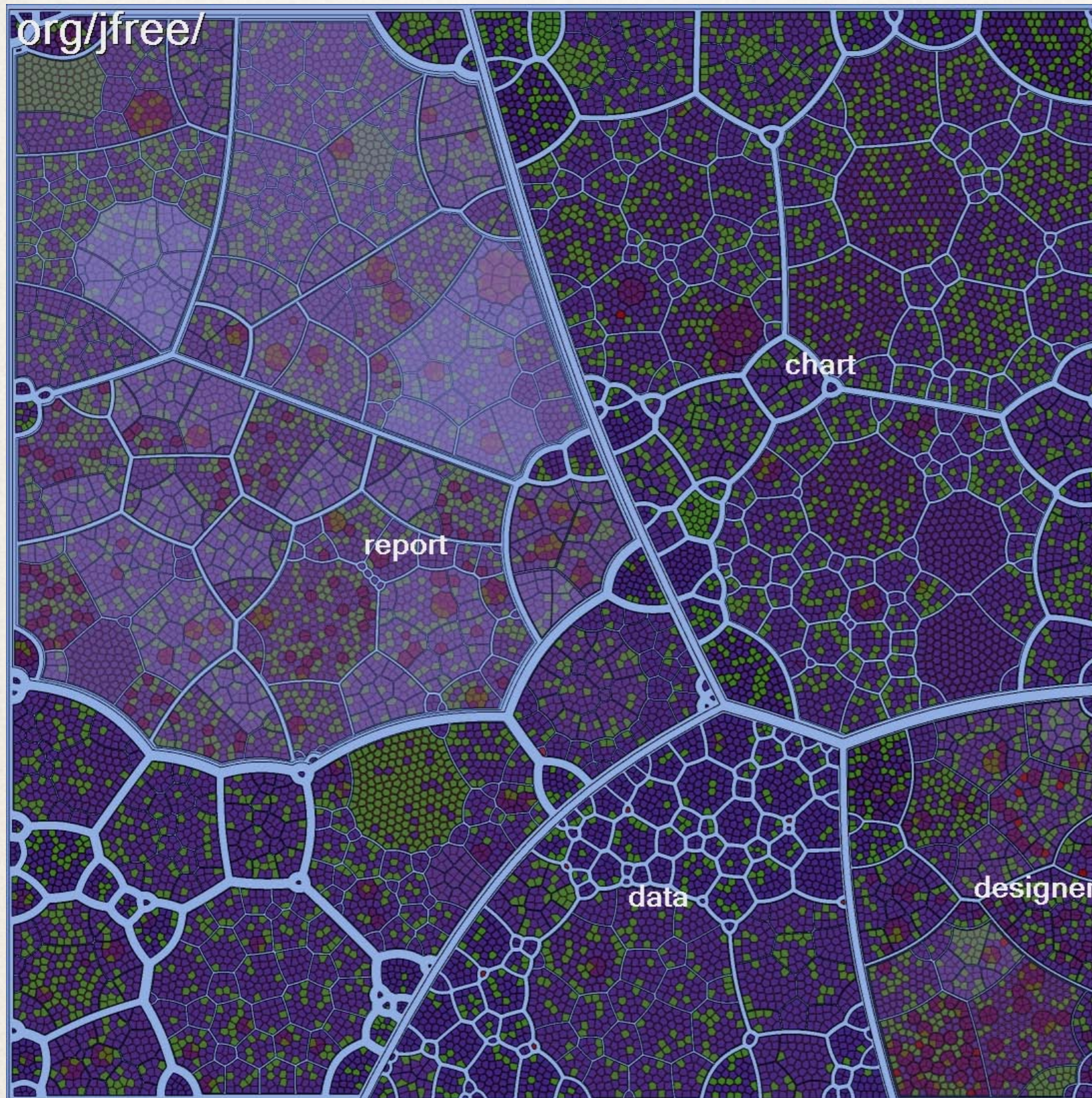
MORE THAN 10 MIN. AGO

MORE THAN 1 HOUR AGO

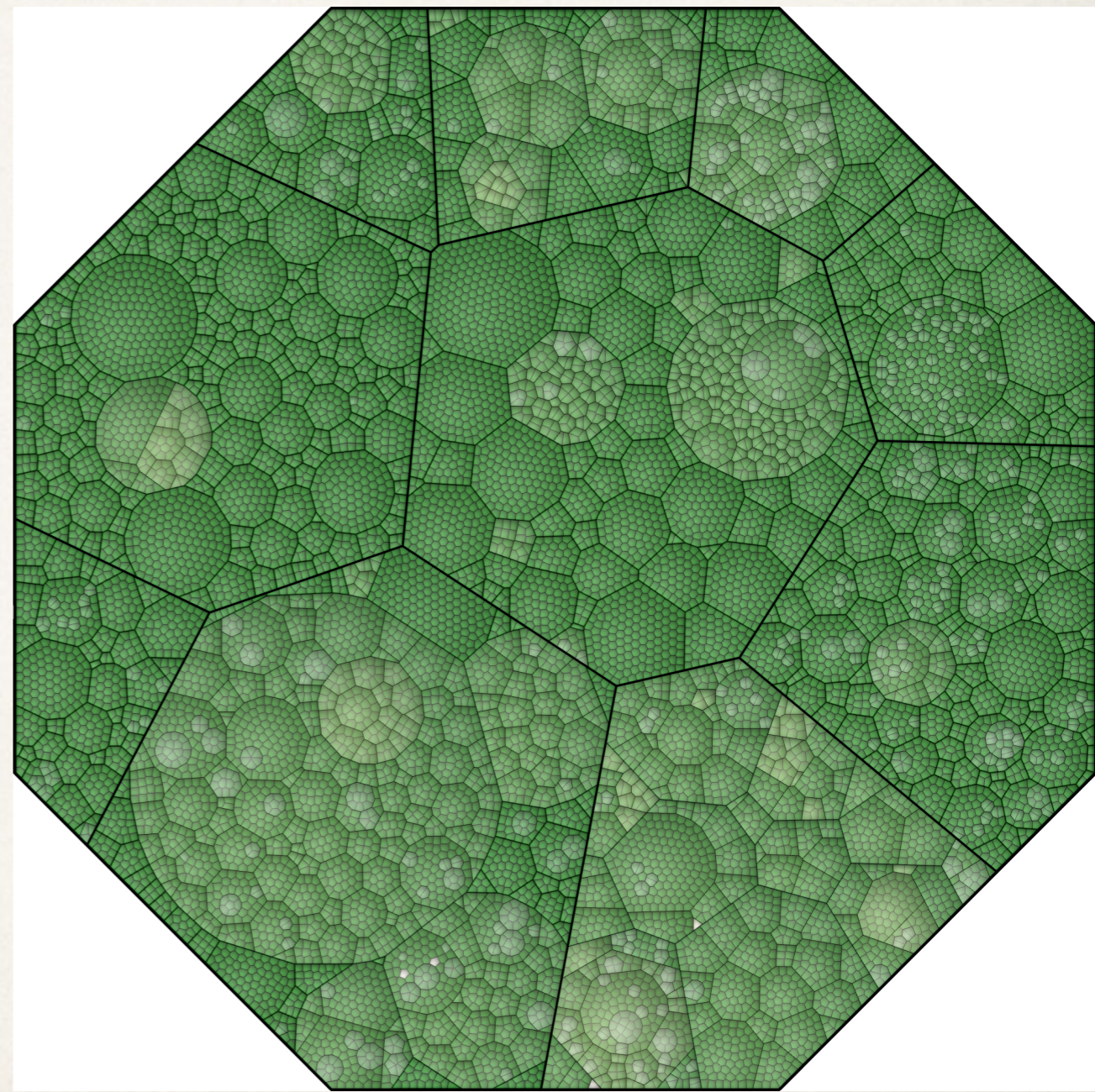
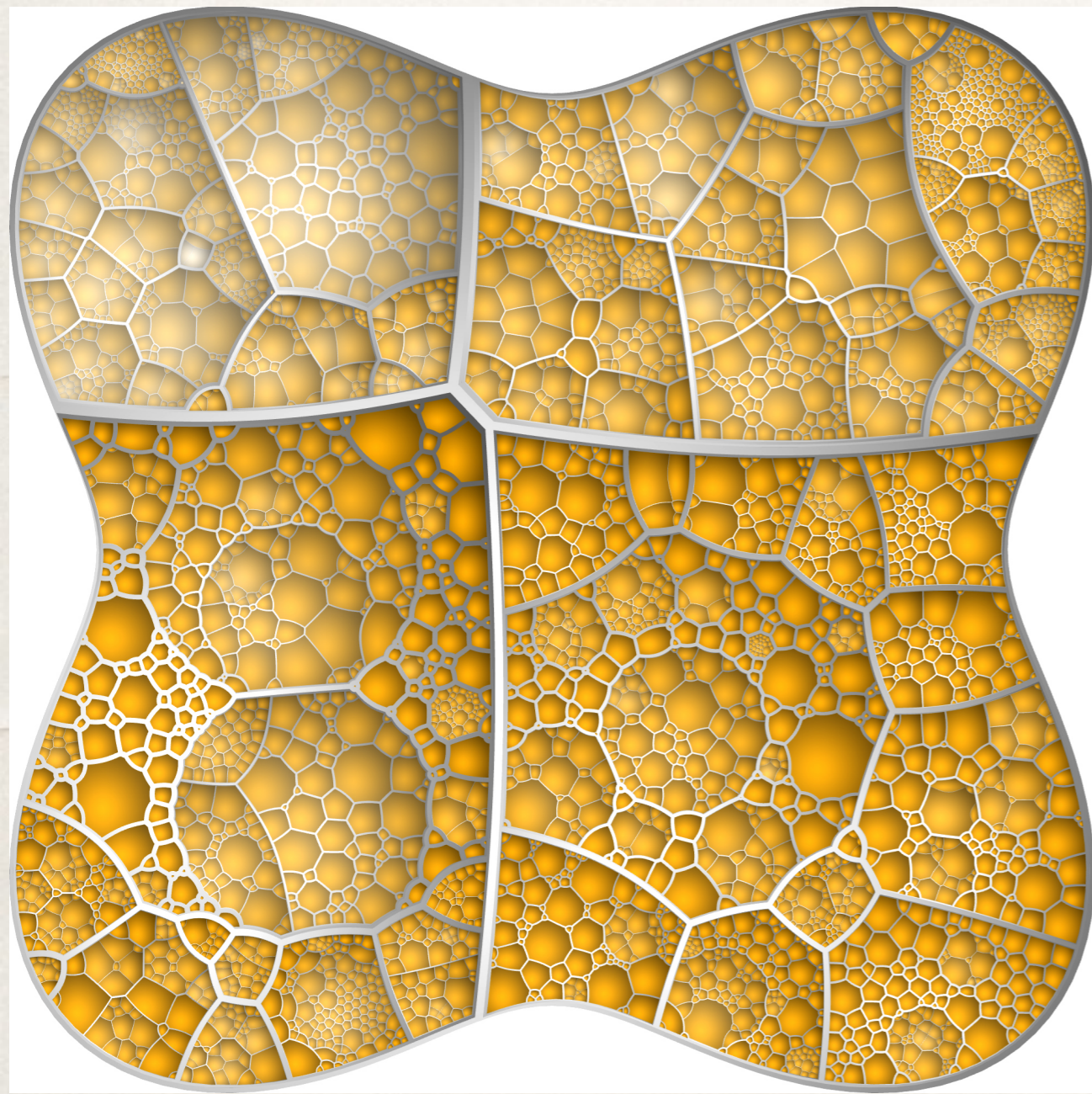
Circular partition treemaps



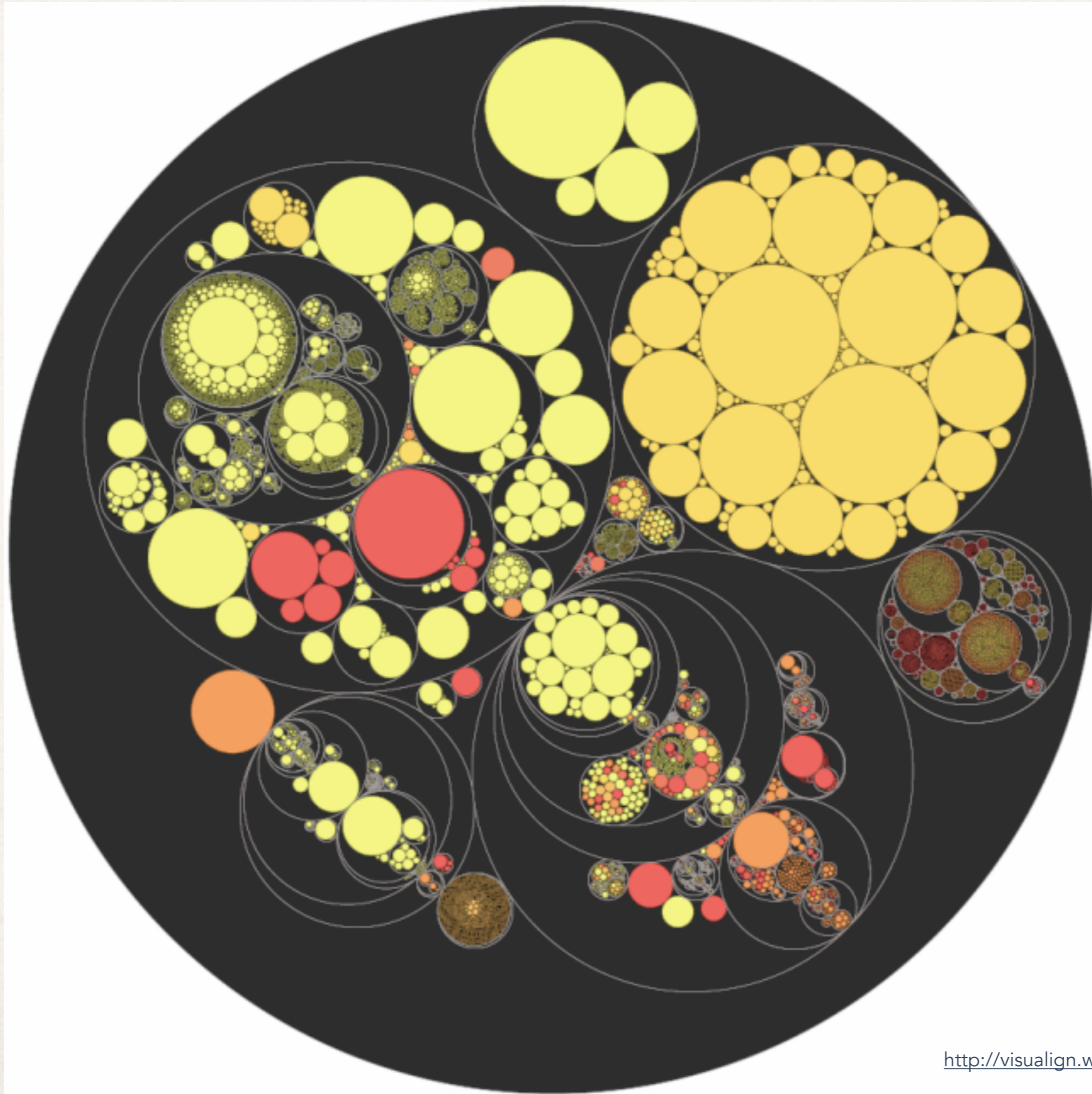
Voronoi treemaps



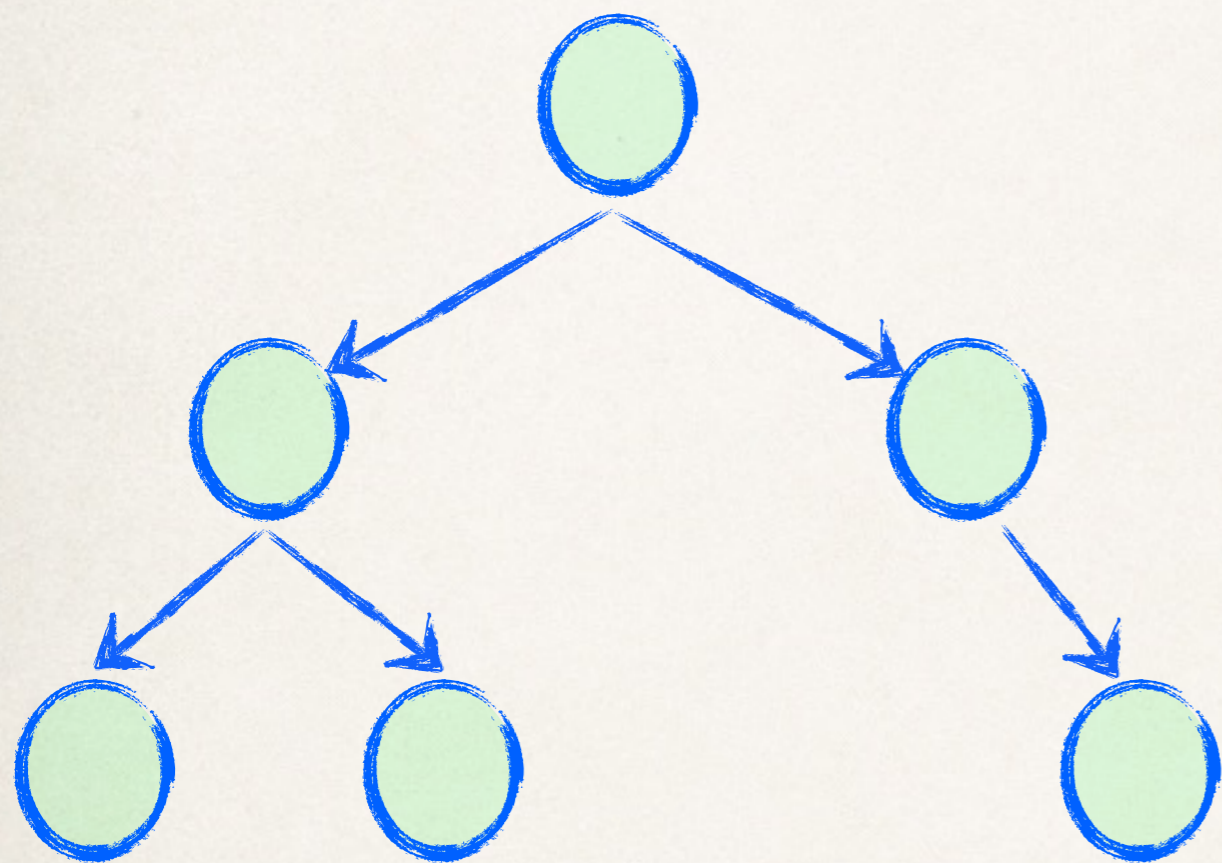
Voronoi Treemaps



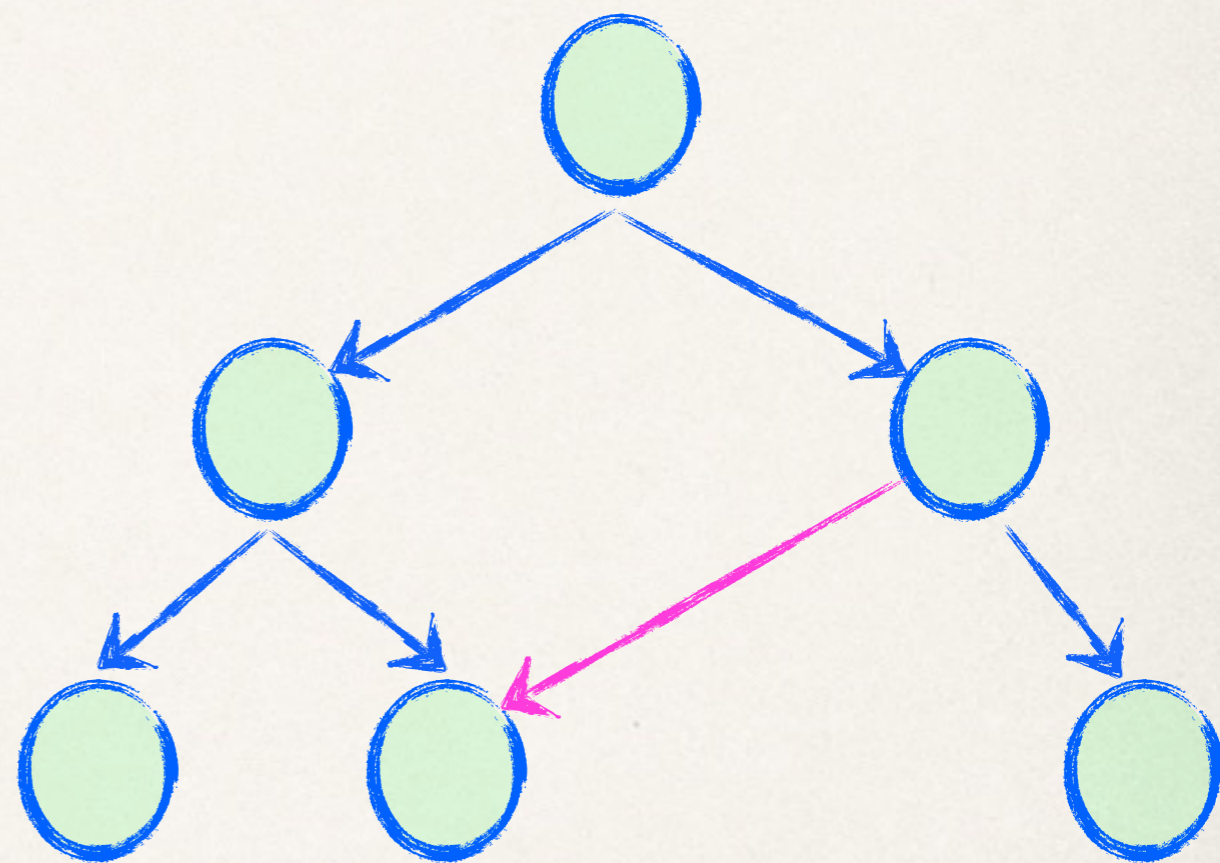
Circular treemaps



Networks



Tree



Network

Graph representations

vertex and edge tables

edge	source	sink	node	attr1	attr2
1	A	B	A	-	-
2	B	C	B	-	-
			C	-	-

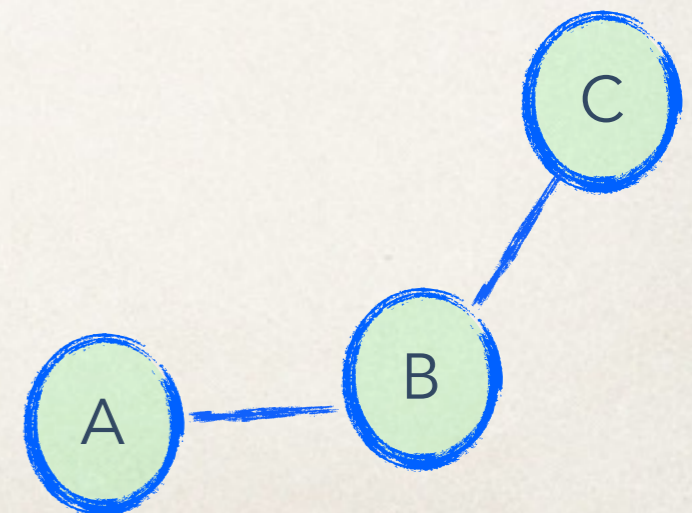
adjacency lists

A: B
B: A, C
C: B

adjacency matrix

	A	B	C
A	0	1	0
B	1	0	1
C	0	1	0

Node - link diagram



Shneiderman's NetViz Nirvana

Every node is visible

For every node, you can count its degree

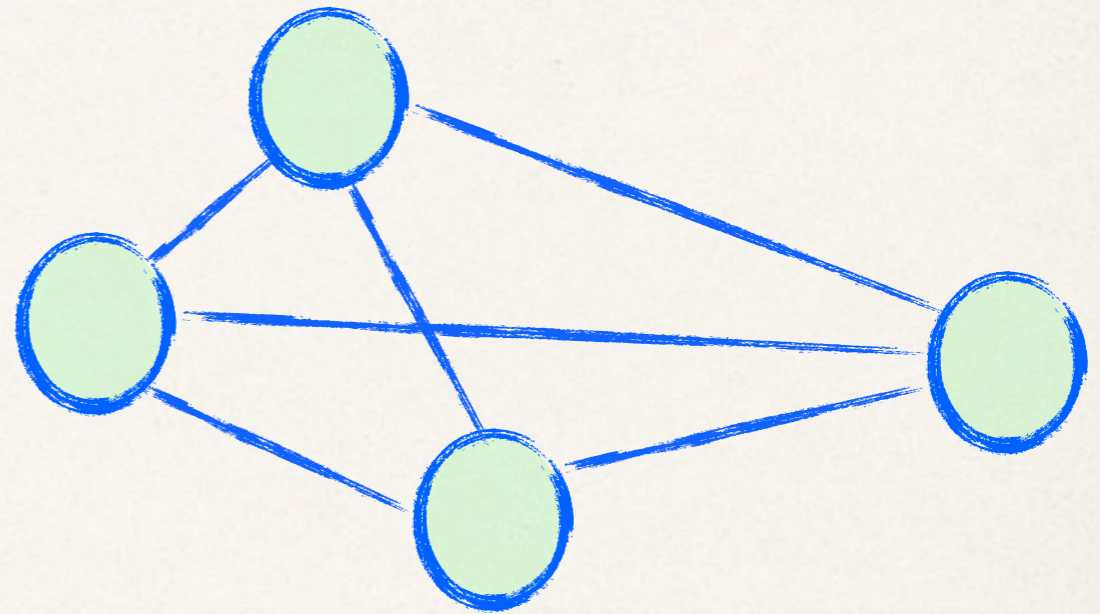
For every link you can follow it from source to destination

Clusters and outliers are identifiable

Aesthetic considerations

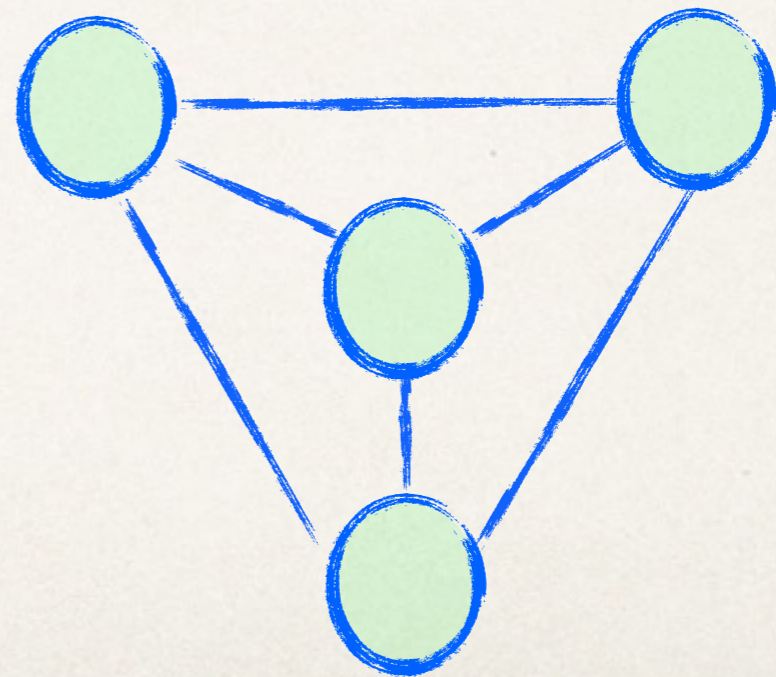
Minimize

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



Maximize

- smallest angle between edges
- symmetry

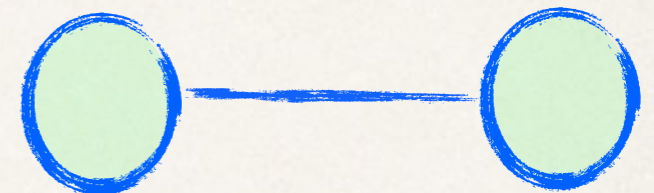


Graph visualization

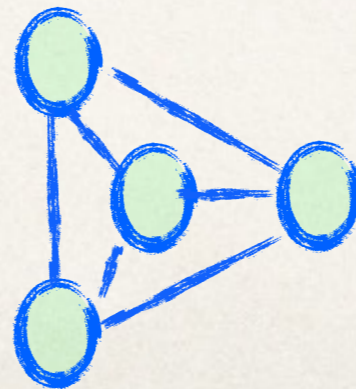
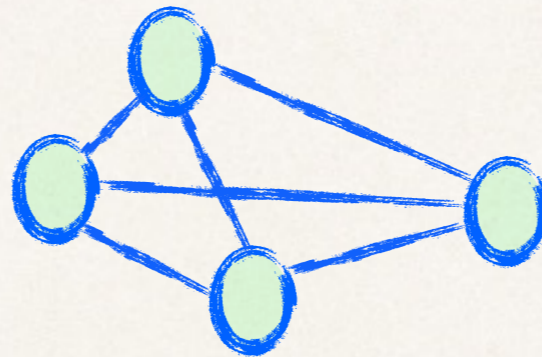
What do nodes look like?



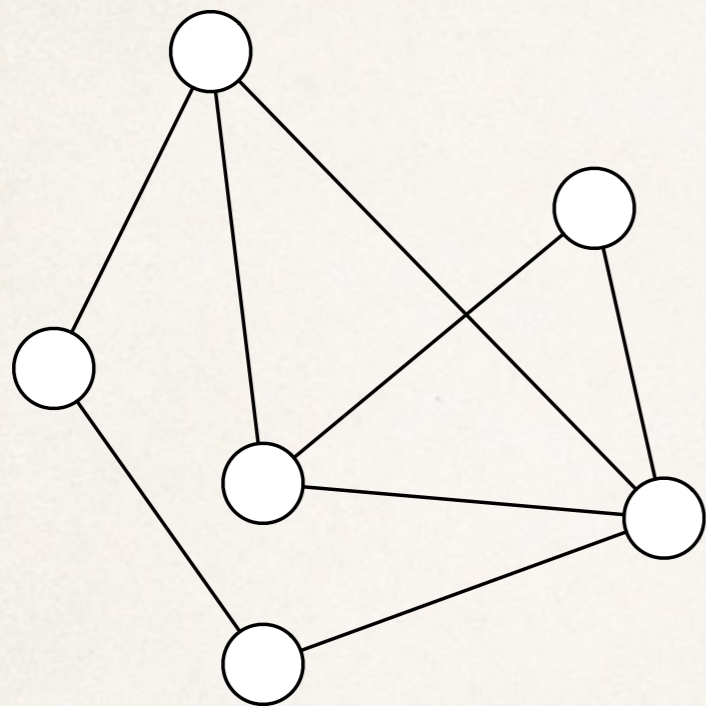
What do links look like?



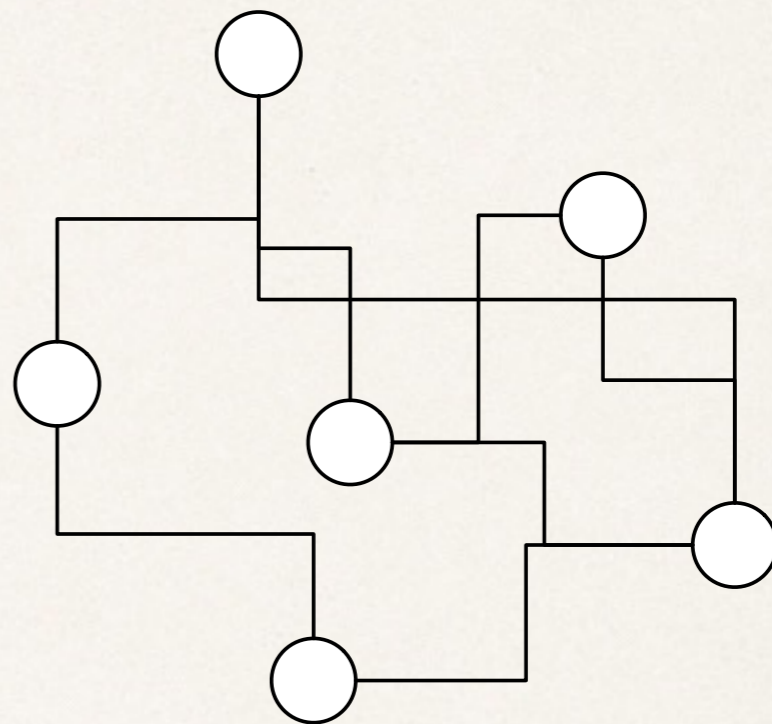
How do we lay out the graph?



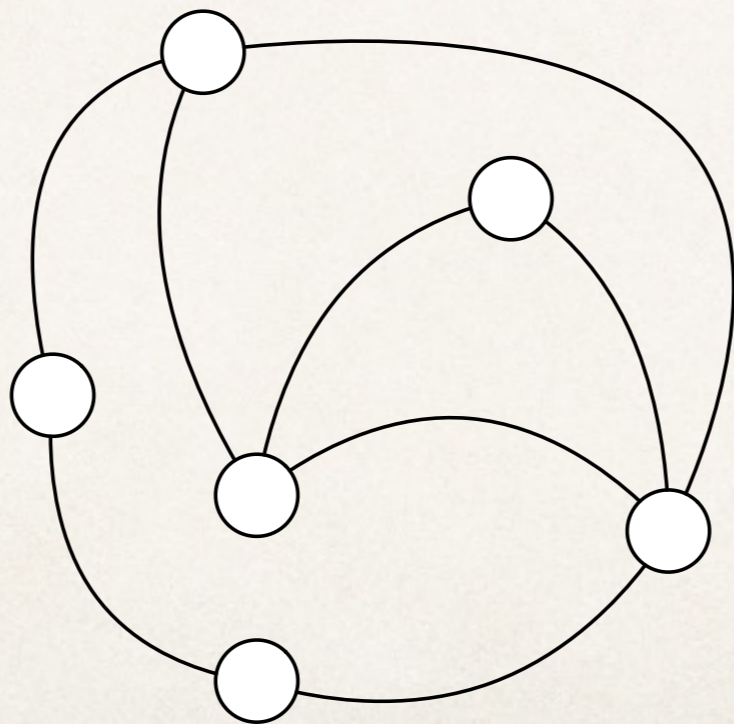
Edge styles



Straight



Orthogonal



Curved

Common layout styles

Hierarchical

Force directed

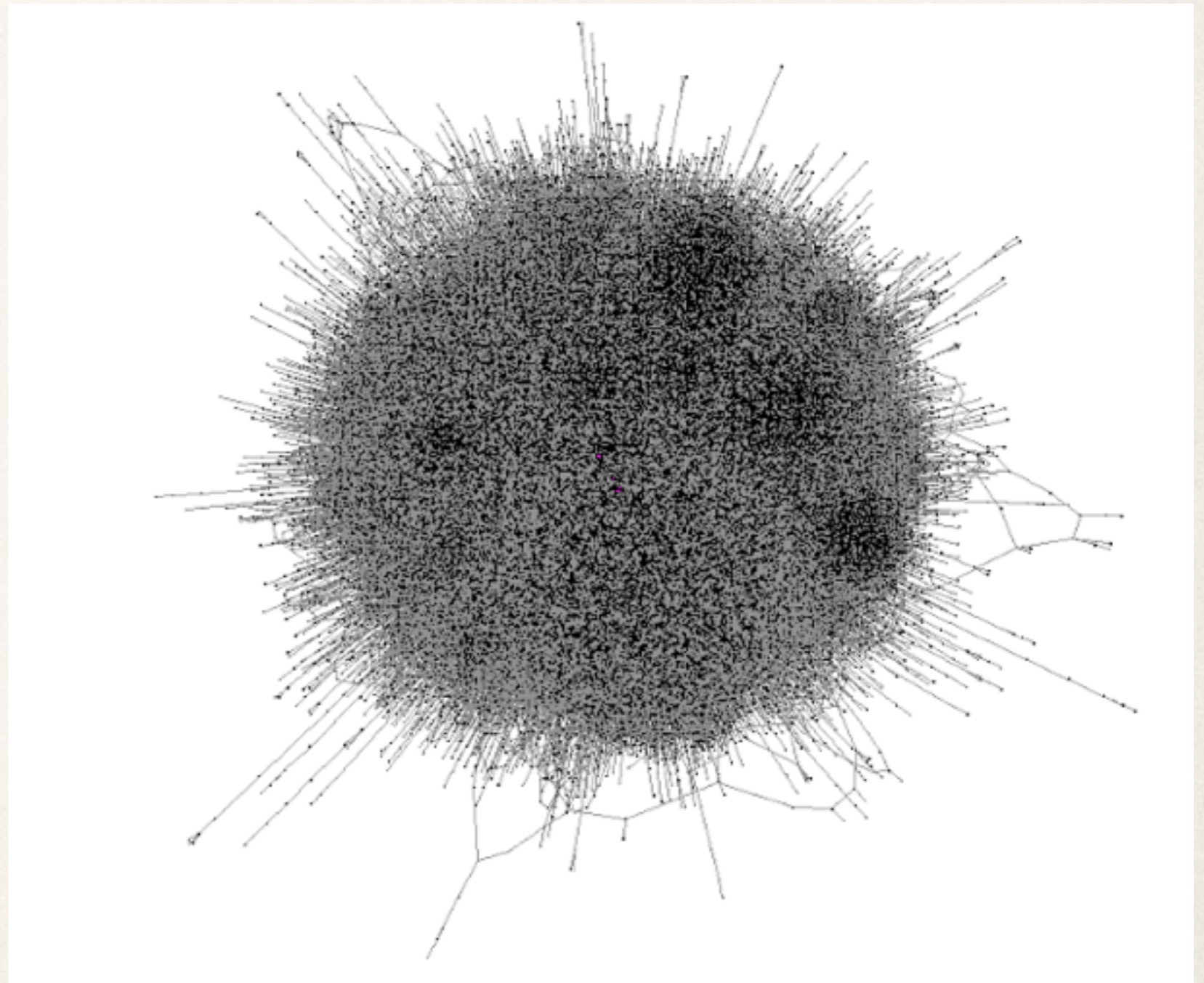
Circular

Geographic

Clustered

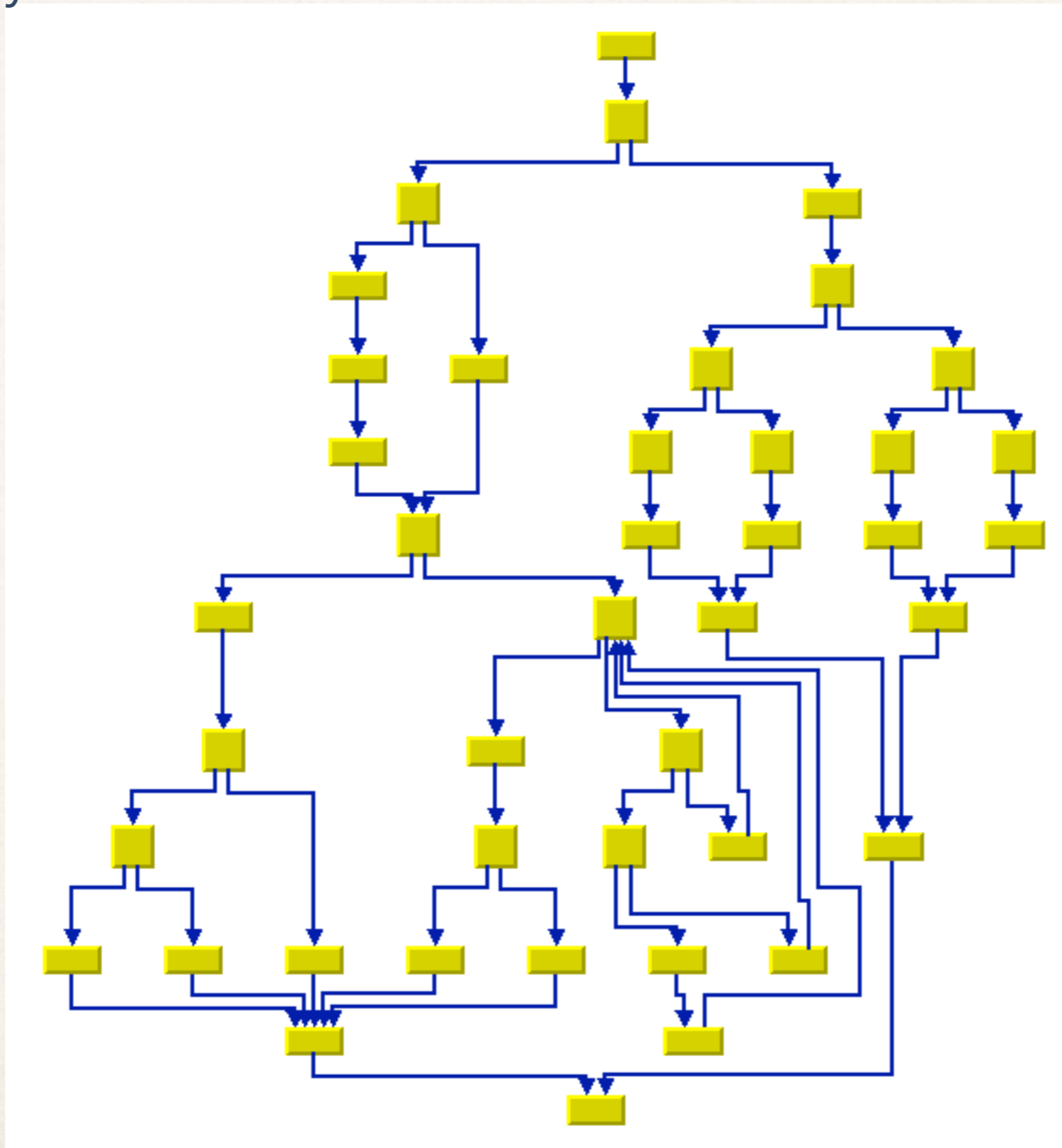
Matrix

Attribute based



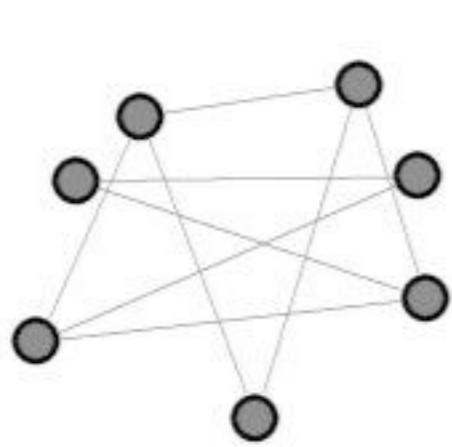
Hierarchical graph layout

Sugiyama layout

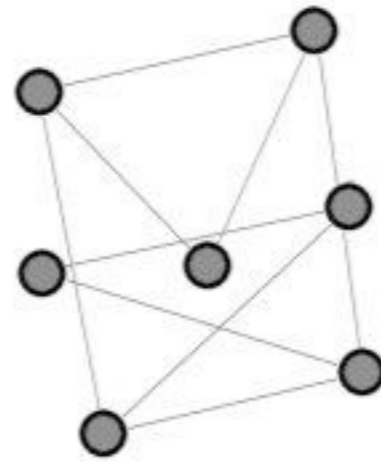


Force-directed layout

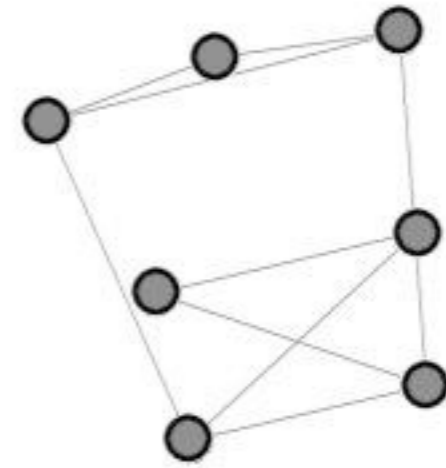
Constraint-based layout



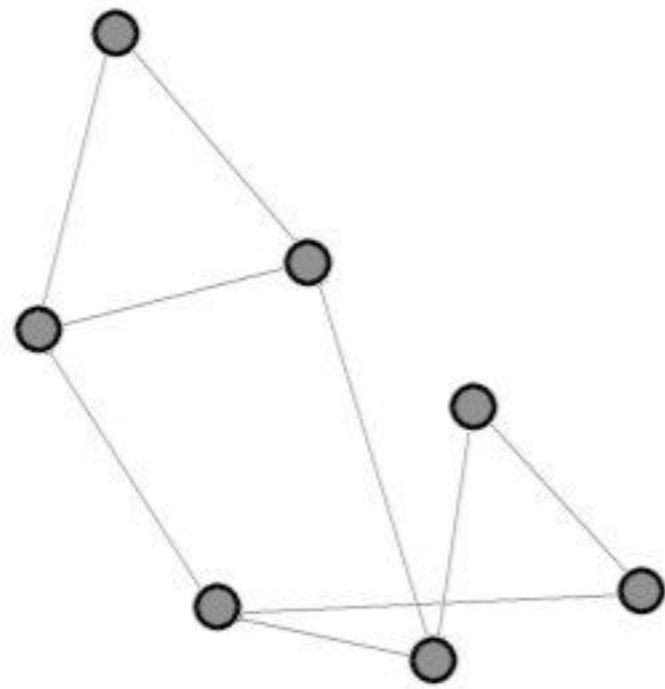
(a)



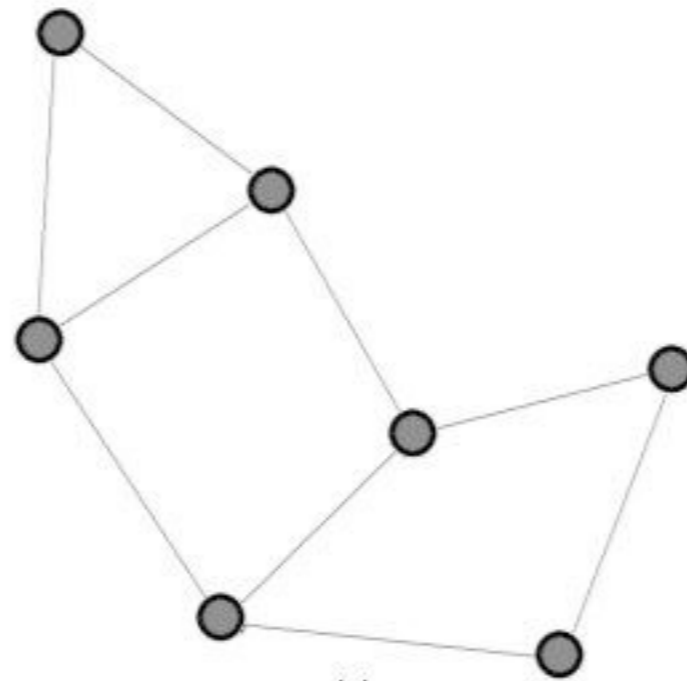
(b)



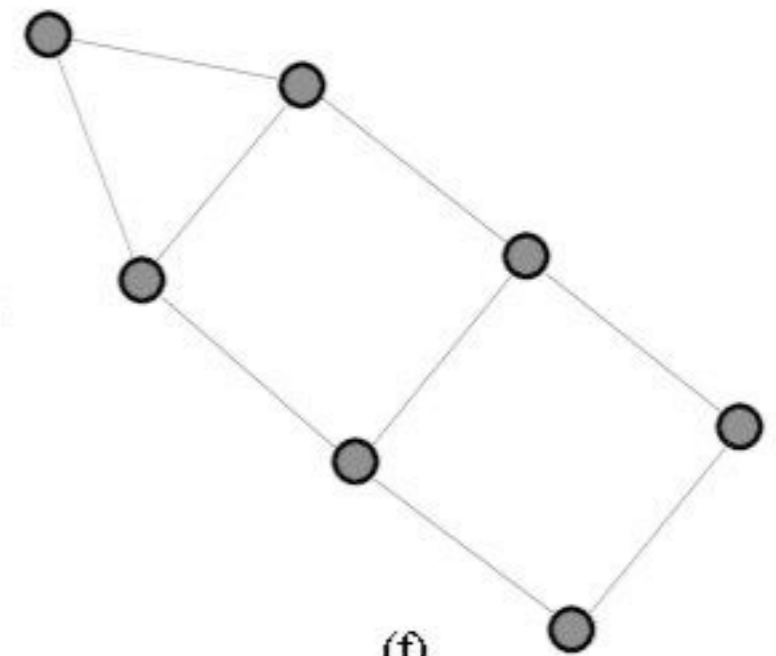
(c)



(d)

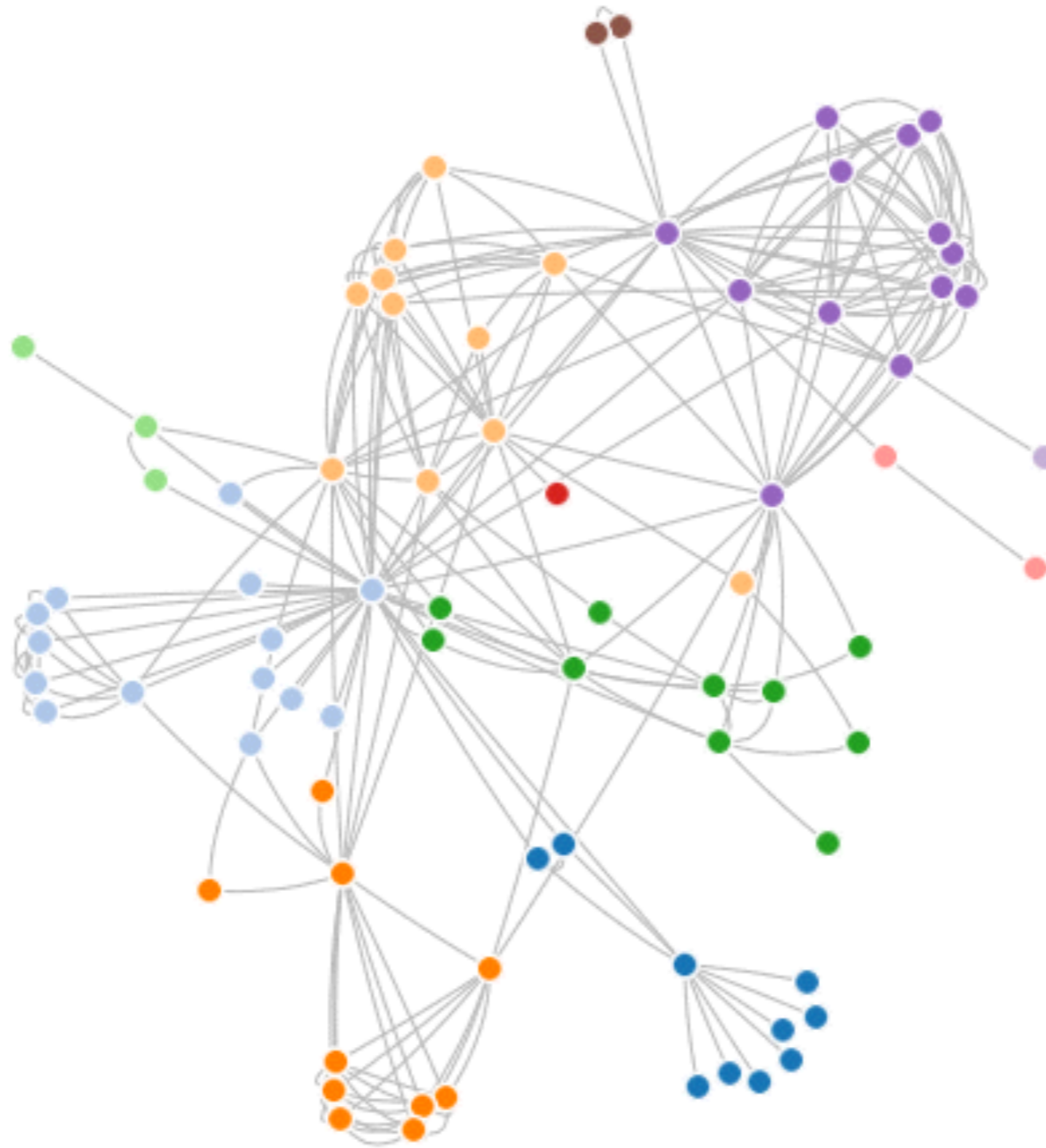


(e)

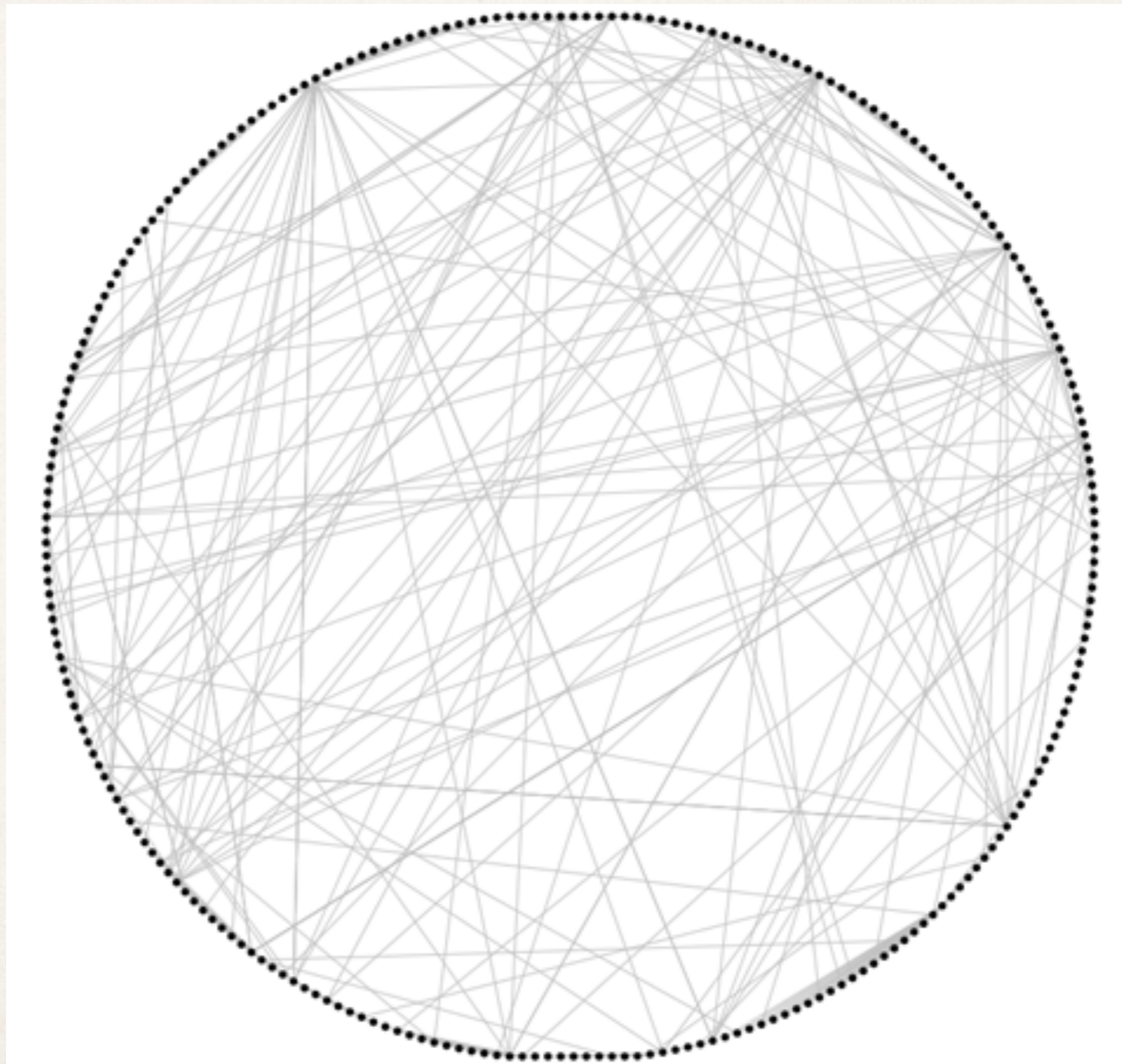


(f)

Force directed layout

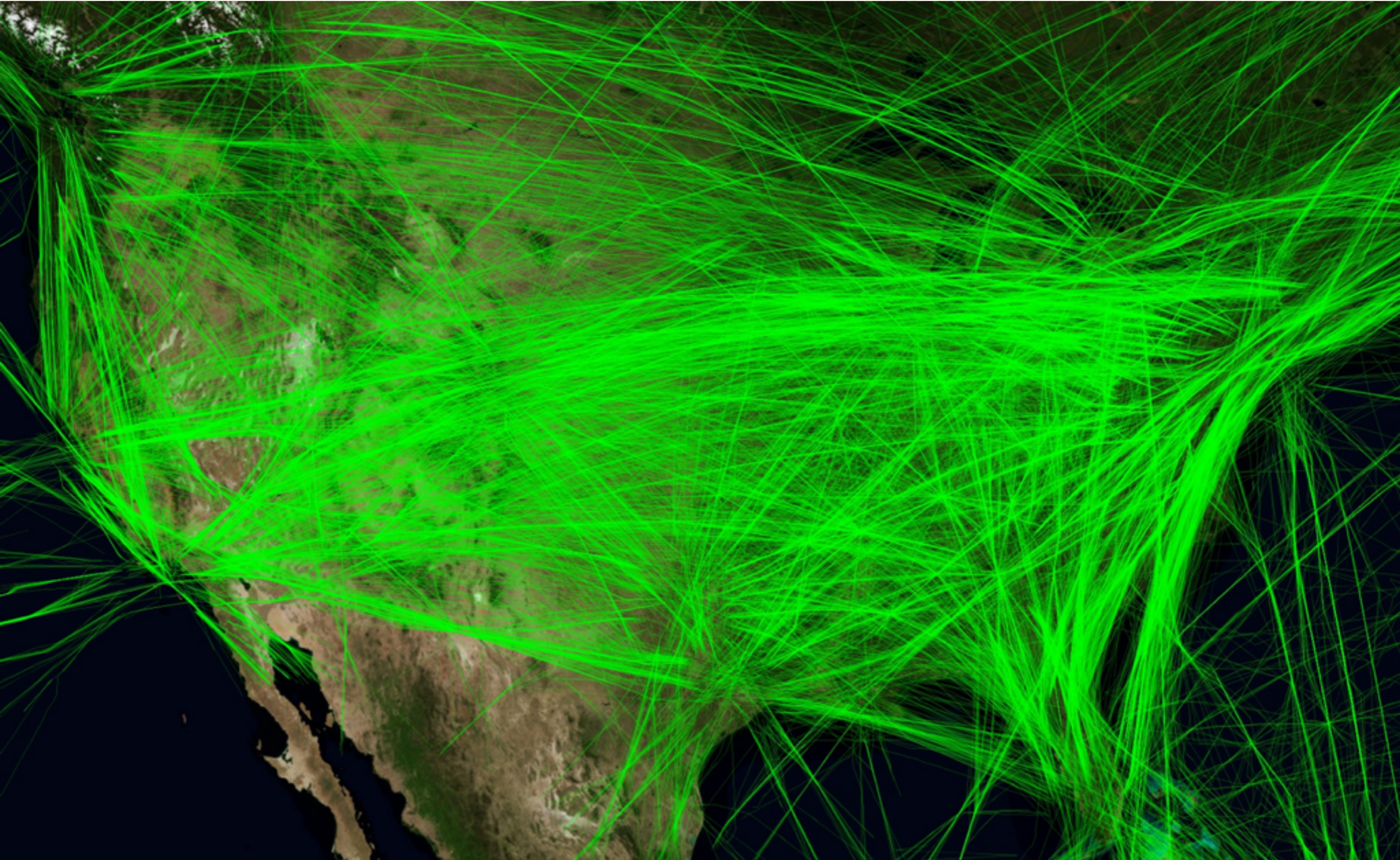


Circular layout

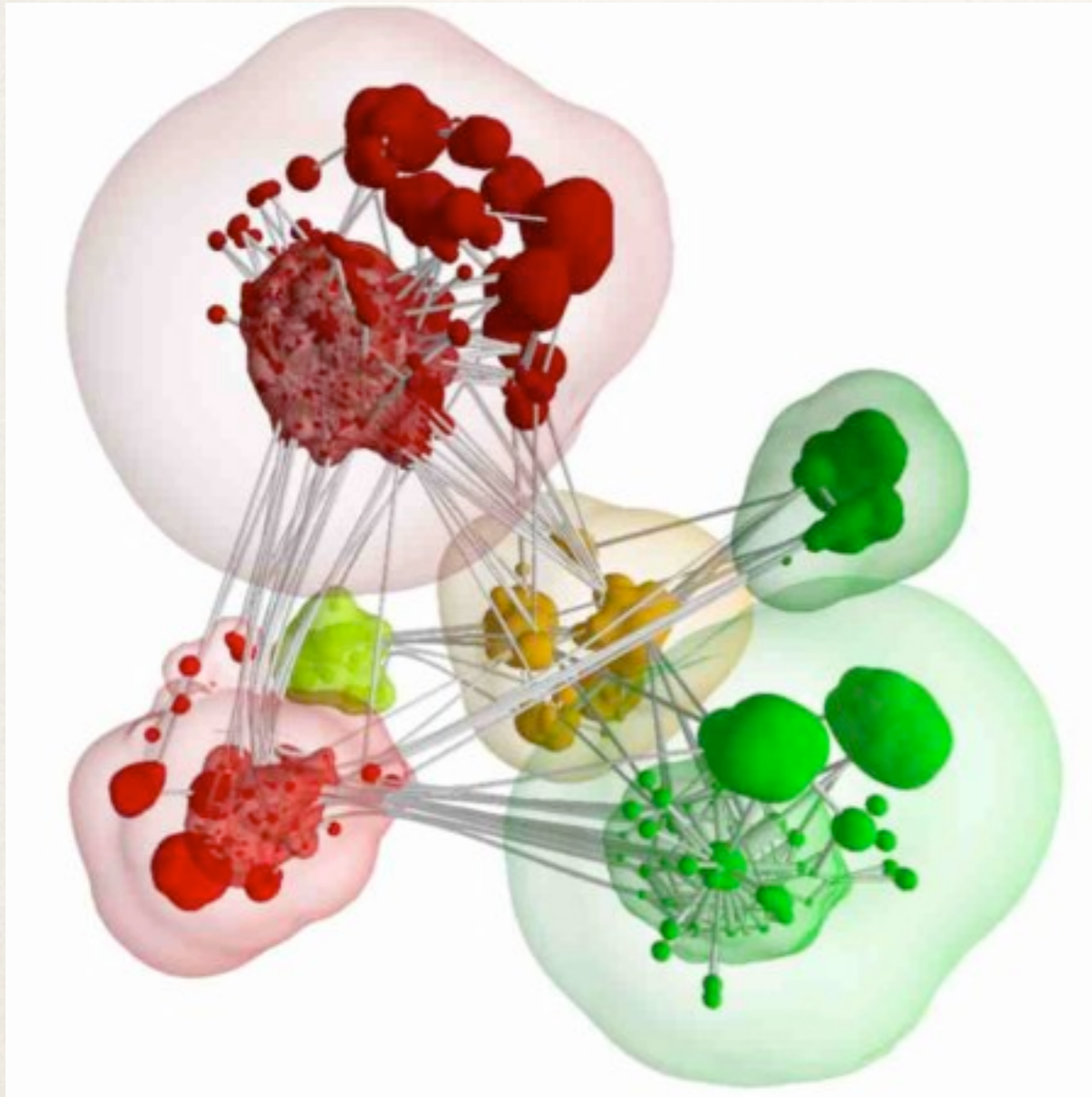




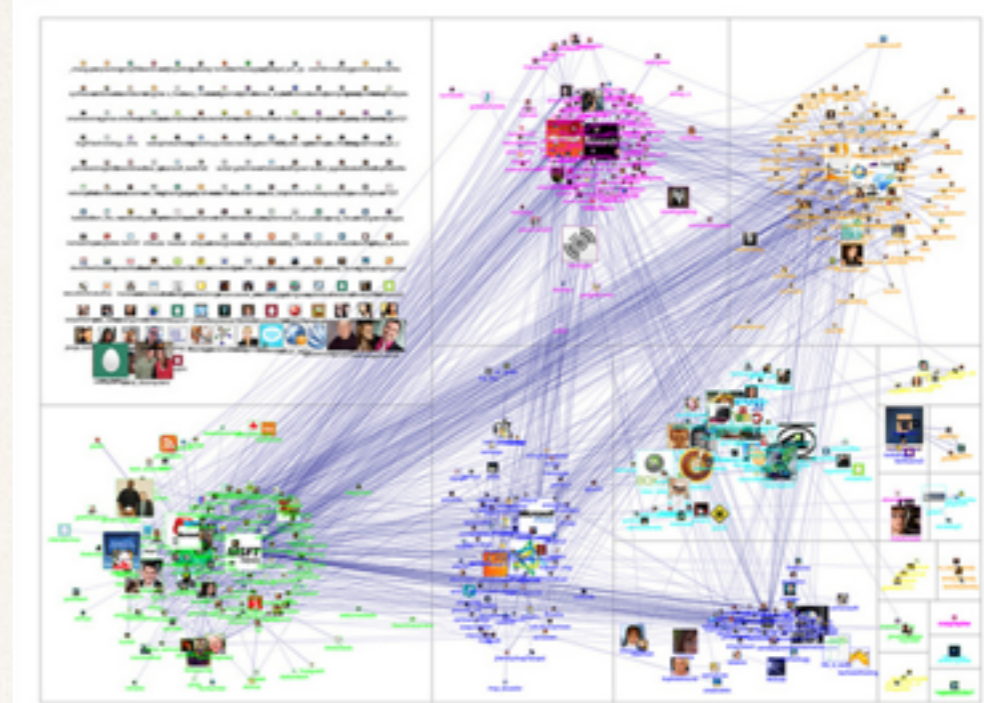
Geographic



Clustered graph layout

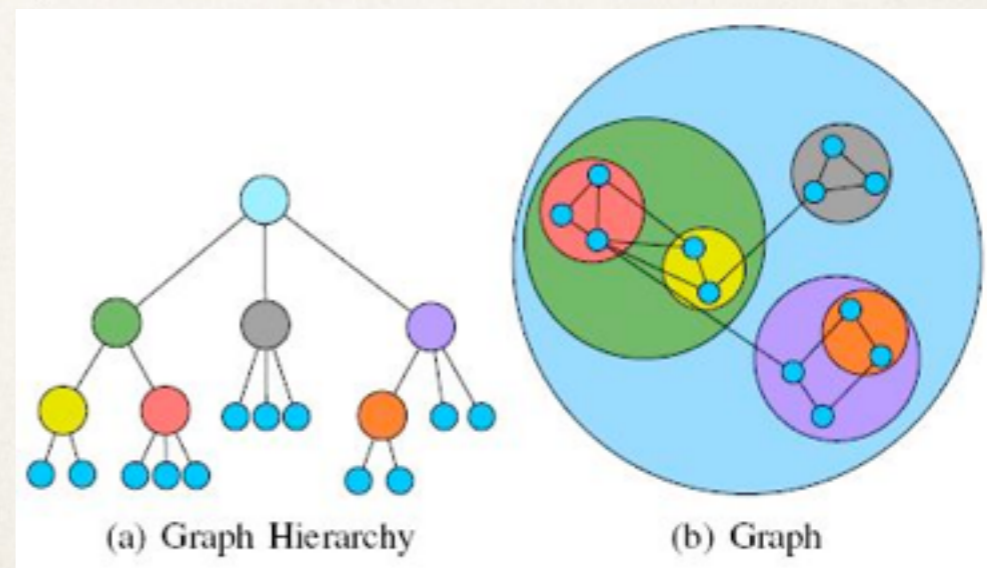


Balzer and Deussen, "Level of Detail Visualization of Clustered Graph Layouts"



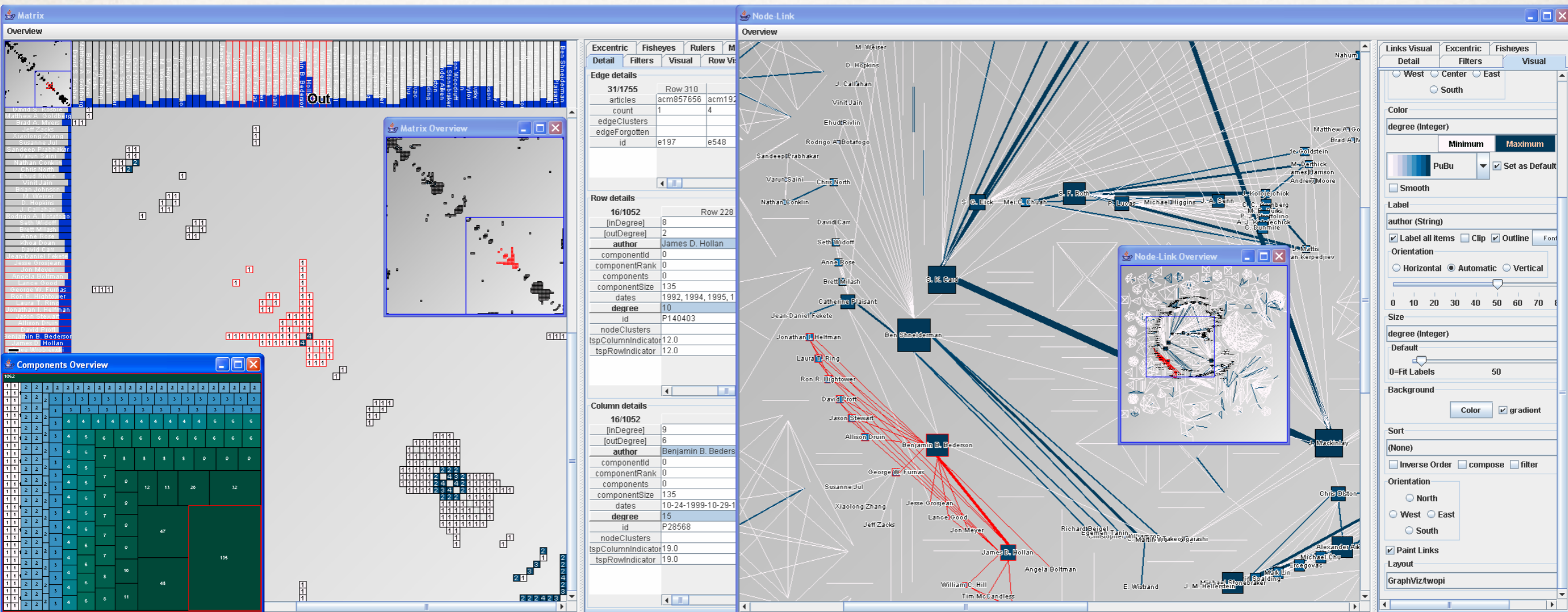
20110313-NodeXL-Twitter-msrtf11 OR techfest group layout

<http://research.microsoft.com/en-us/projects/nodexl/>



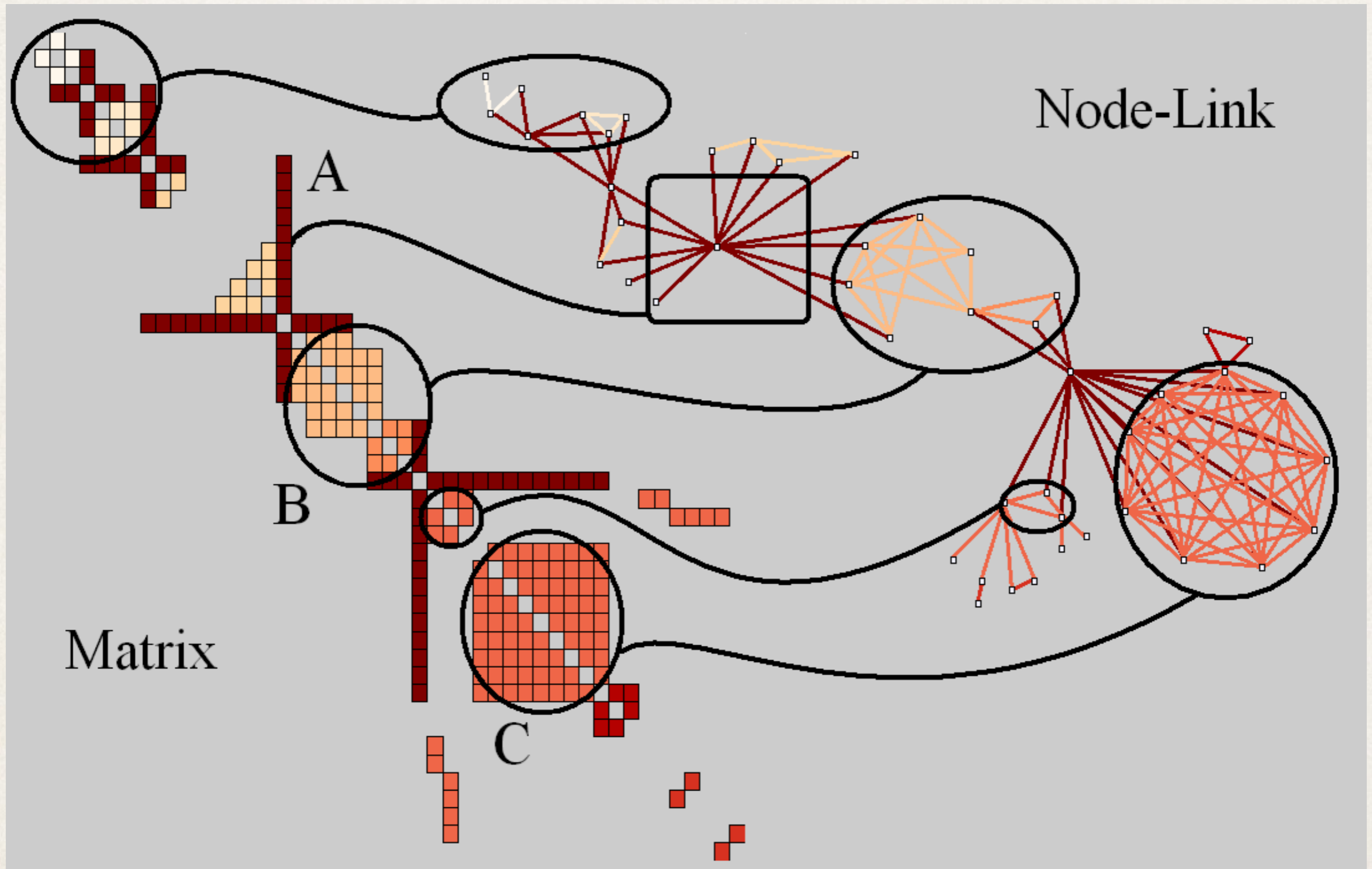
<http://www.personal.psu.edu/lug129/blogs/serendipity/graph-drawing/>

MatrixExplorer

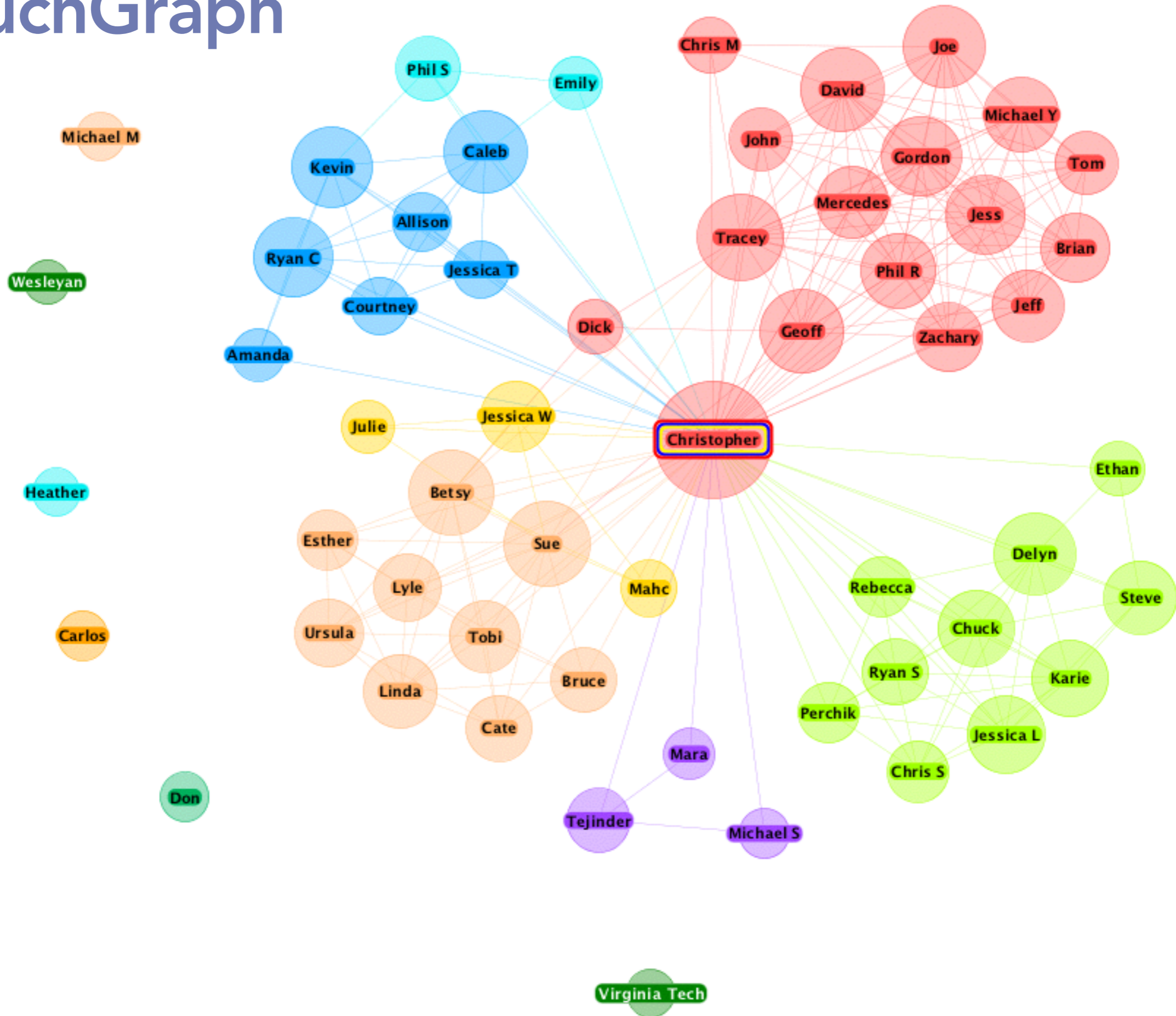


Henry and Fekete, "MatrixExplorer: a Dual-Representation System to Explore Social Networks"

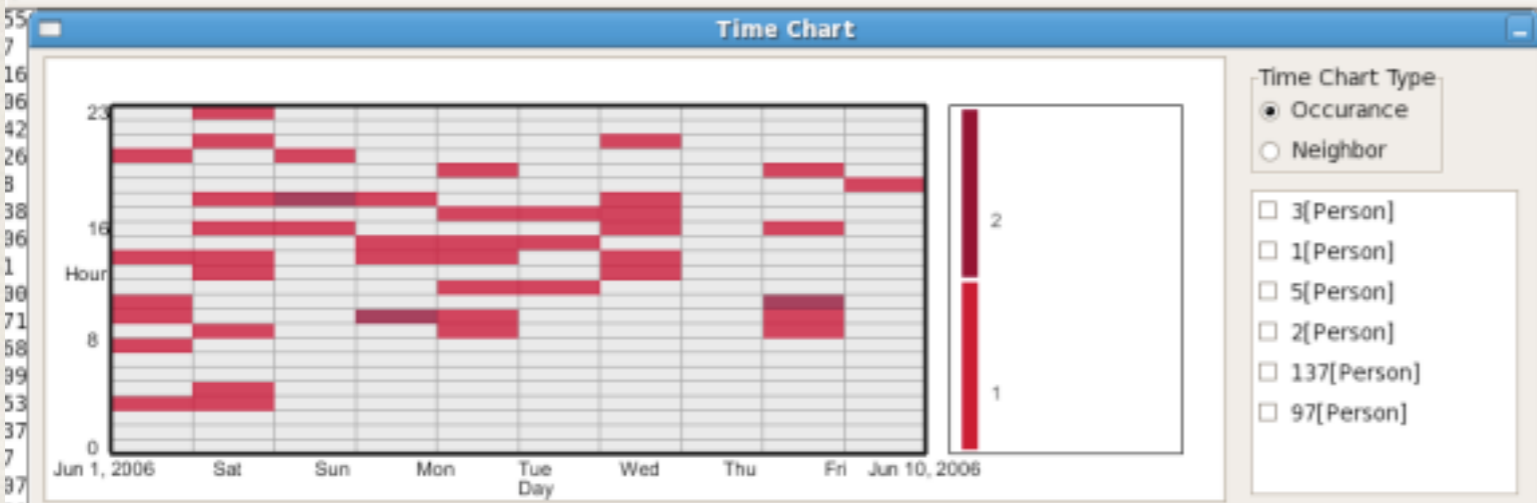
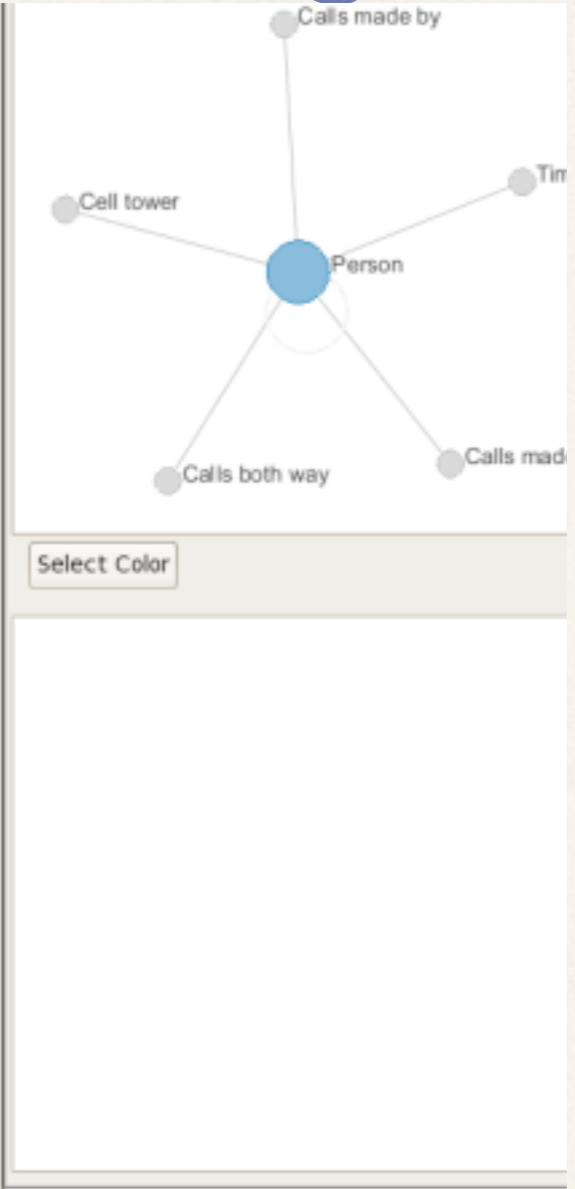
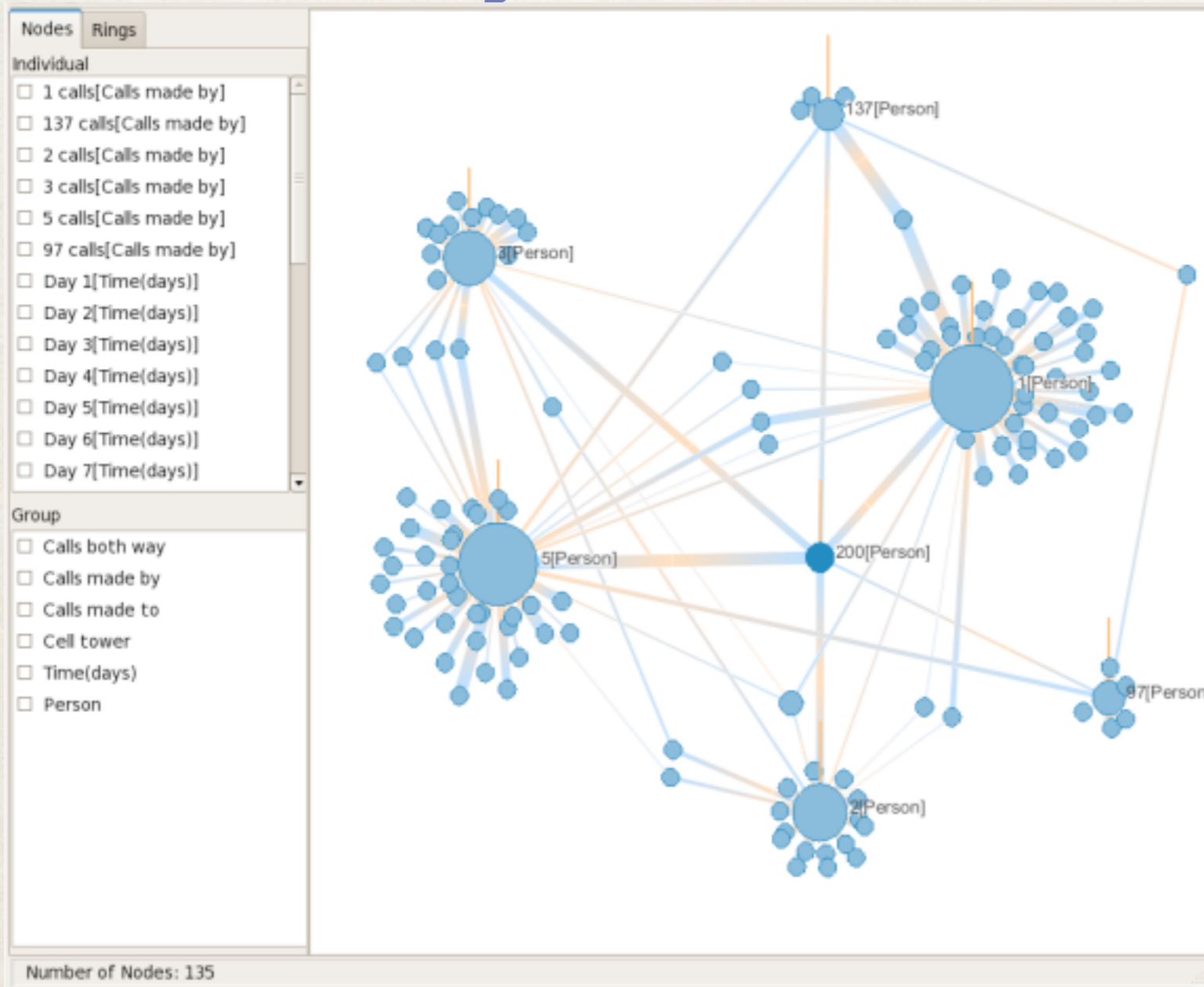
MatrixExplorer



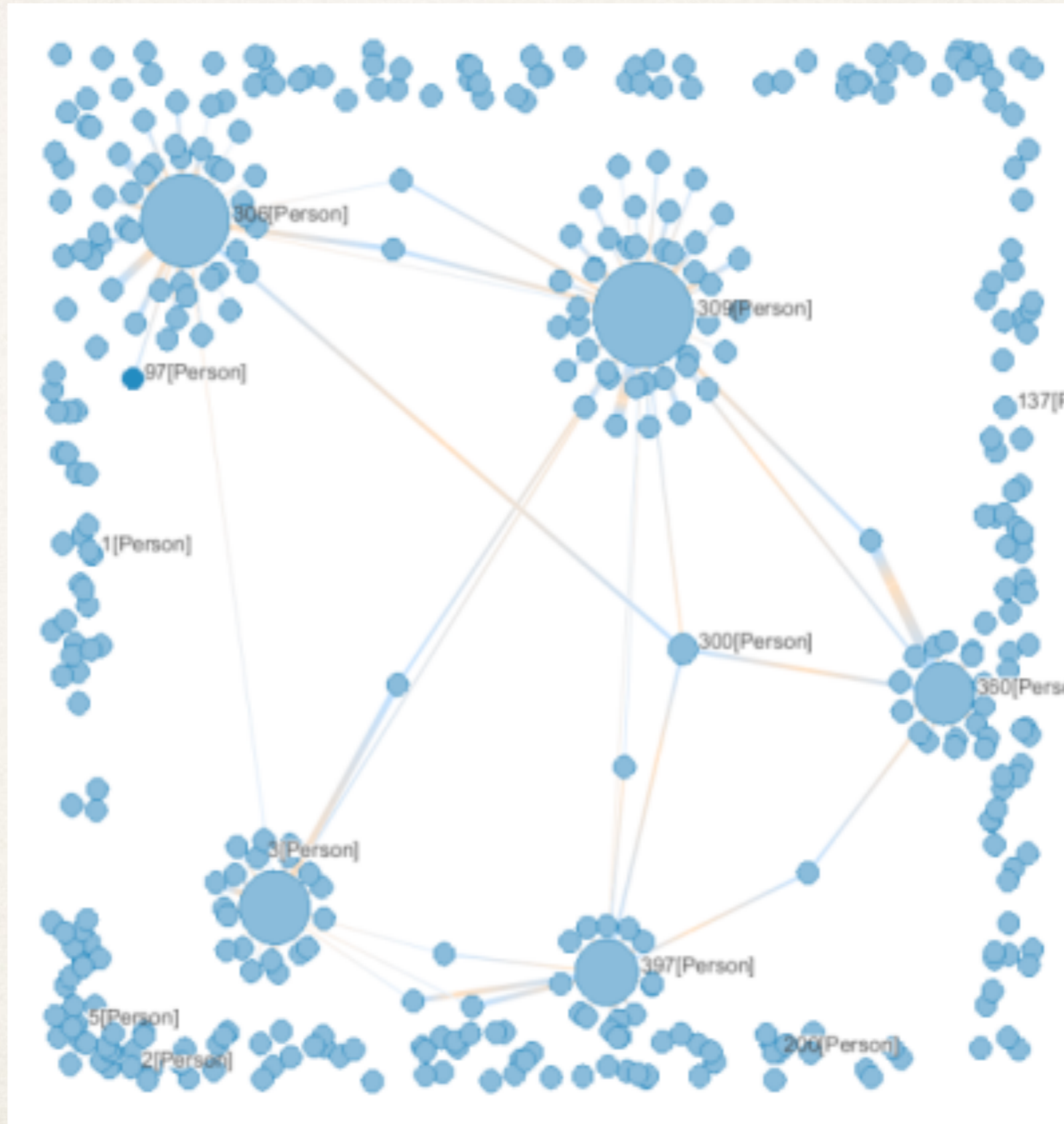
TouchGraph



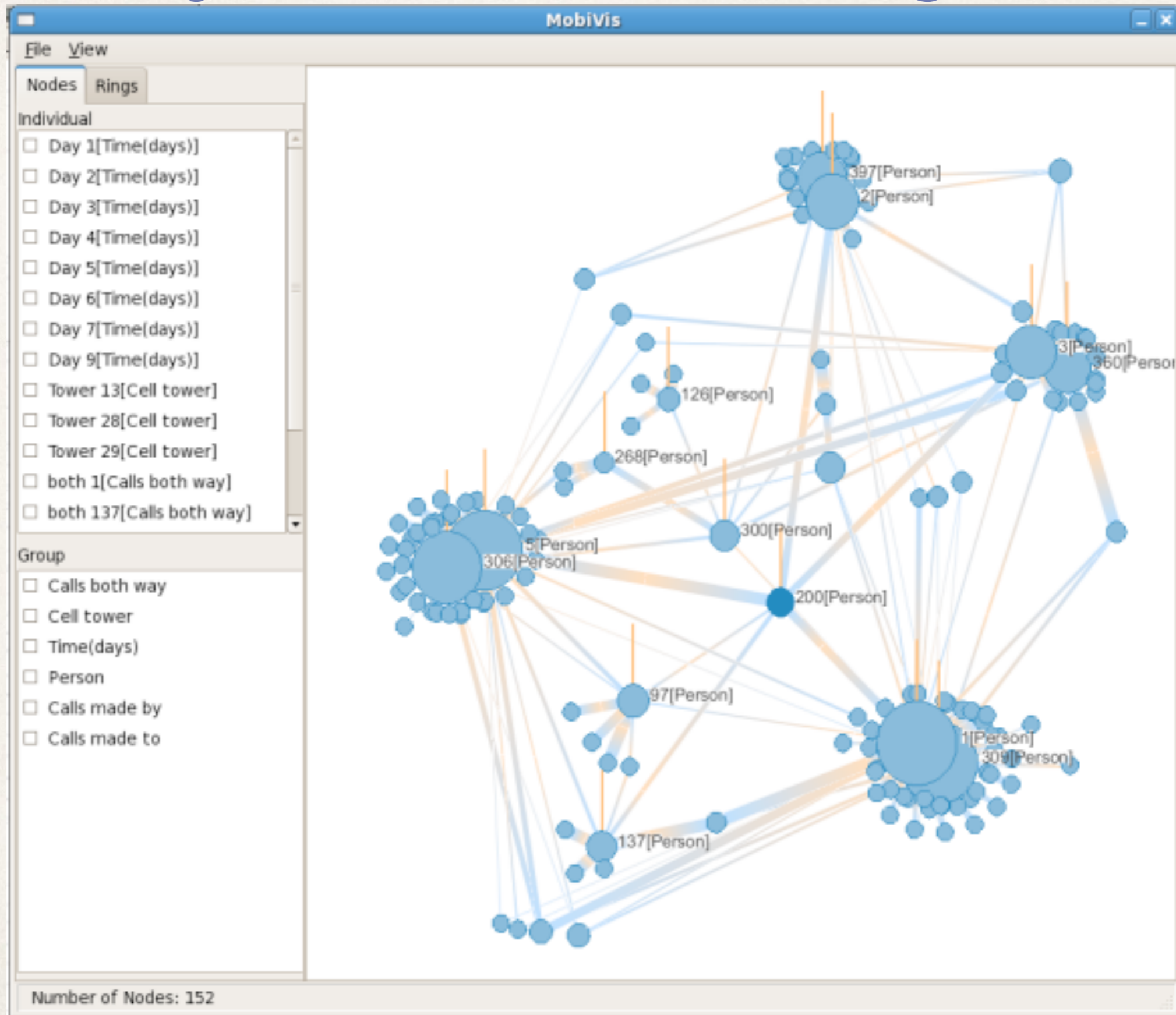
Case Study: VAST 2008 Challenge



Case Study: VAST 2008 Challenge



Case Study: VAST 2008 Challenge



Jigsaw

