上海科技大学
ShanghaiTech University

ARTS1422 Data Visualization

Lecture 9

Hierarchical Data Visualization

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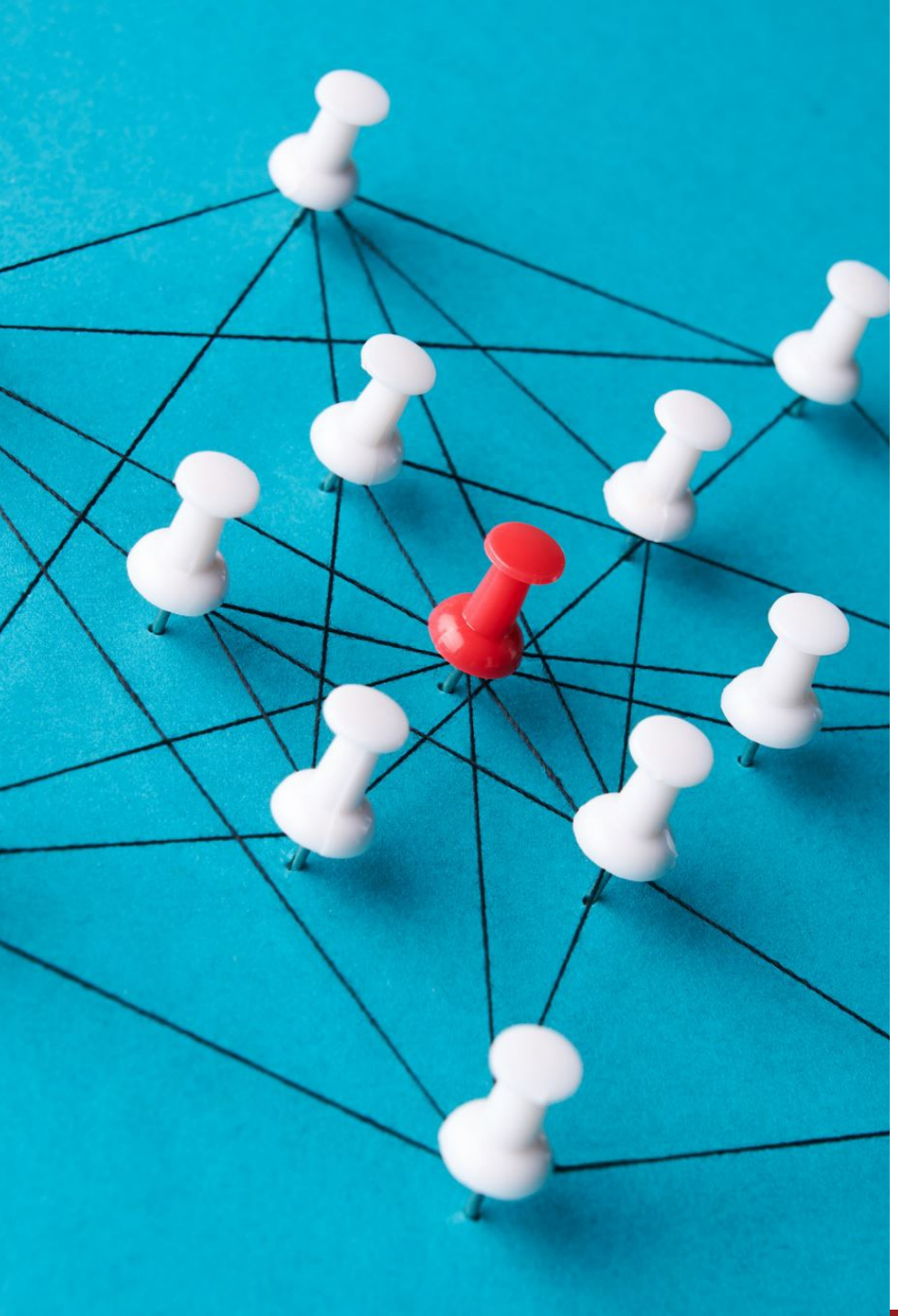
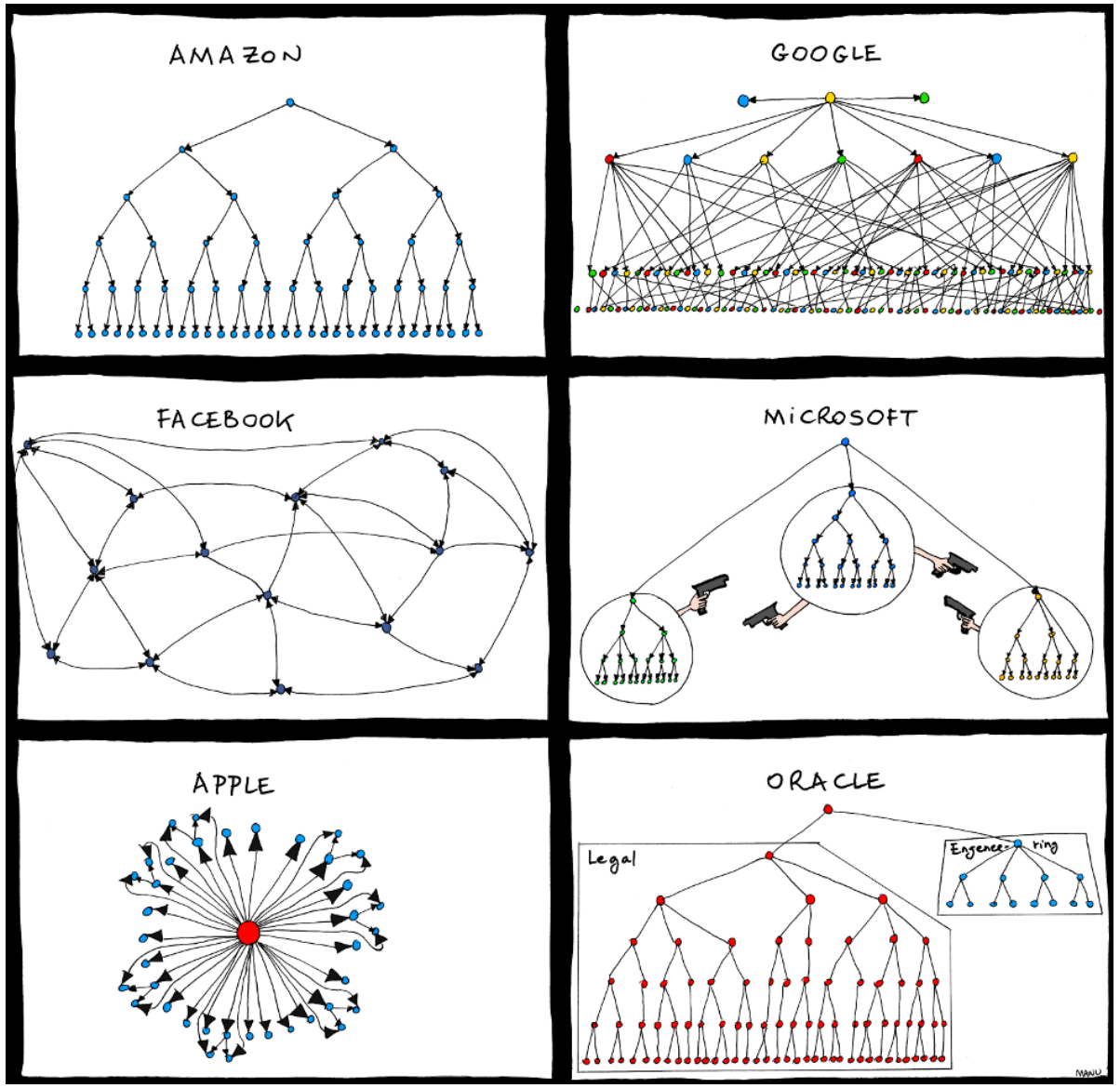
Spring 2024

2024.03.26



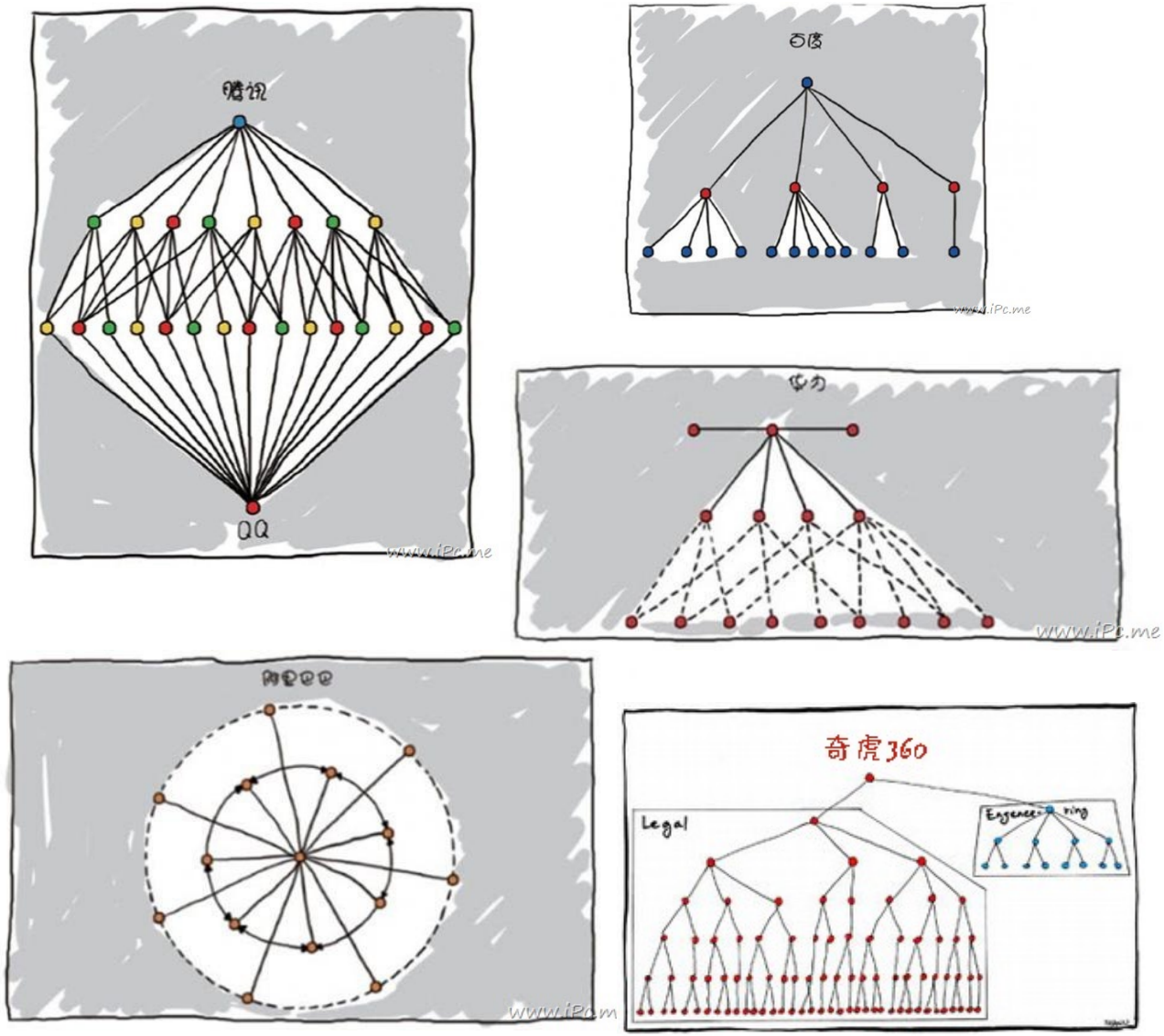
Hierarchical Data

- It focuses on the hierarchical relationship between objects.
  - Social affiliations.
  - Information organization.
    - File directories.
    - Development of species.
  - Logical connections.
    - Decision tree.



Company Organization

http://www.bonkersworld.net/2011/06/27/organizational-charts/

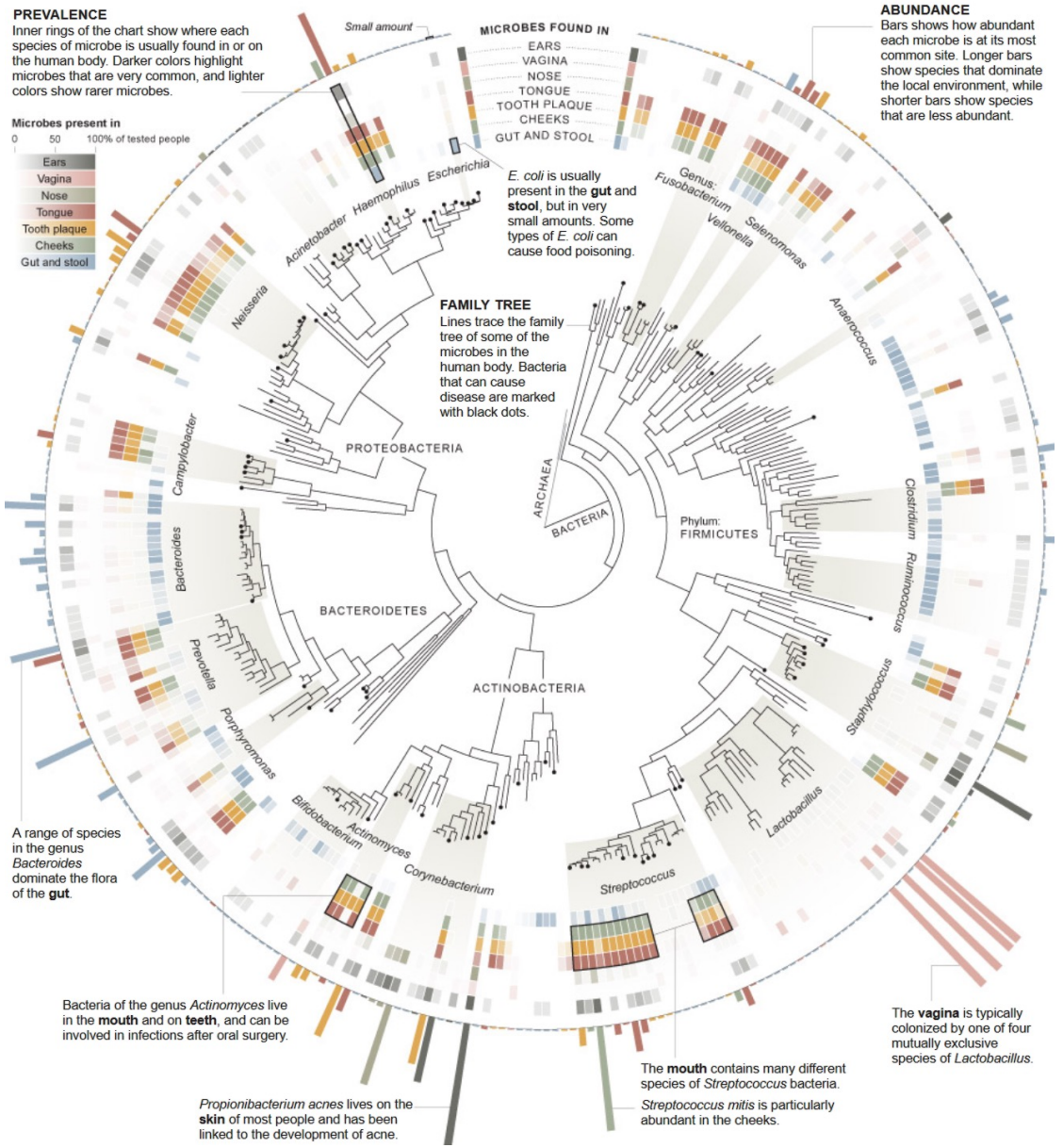


QQ	Baidu
	Huawei
Alibaba	360

Chinese Version

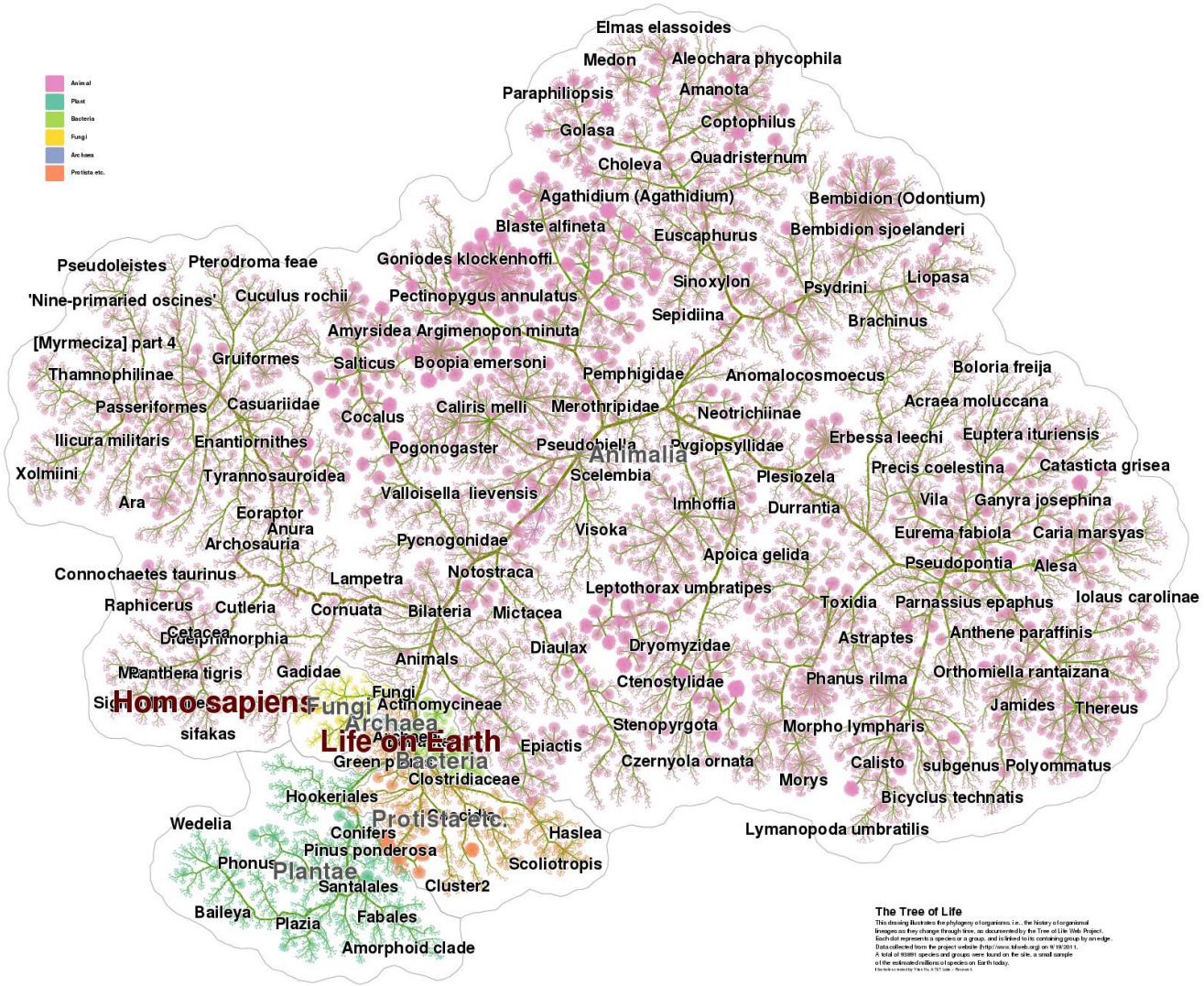
Invisible Residents

The Human Microbiome Project has spent two years surveying bacteria and other microbes at different sites on 242 healthy people. The chart below hints at the complex combinations of microbes living in and on the human body. Related Article »



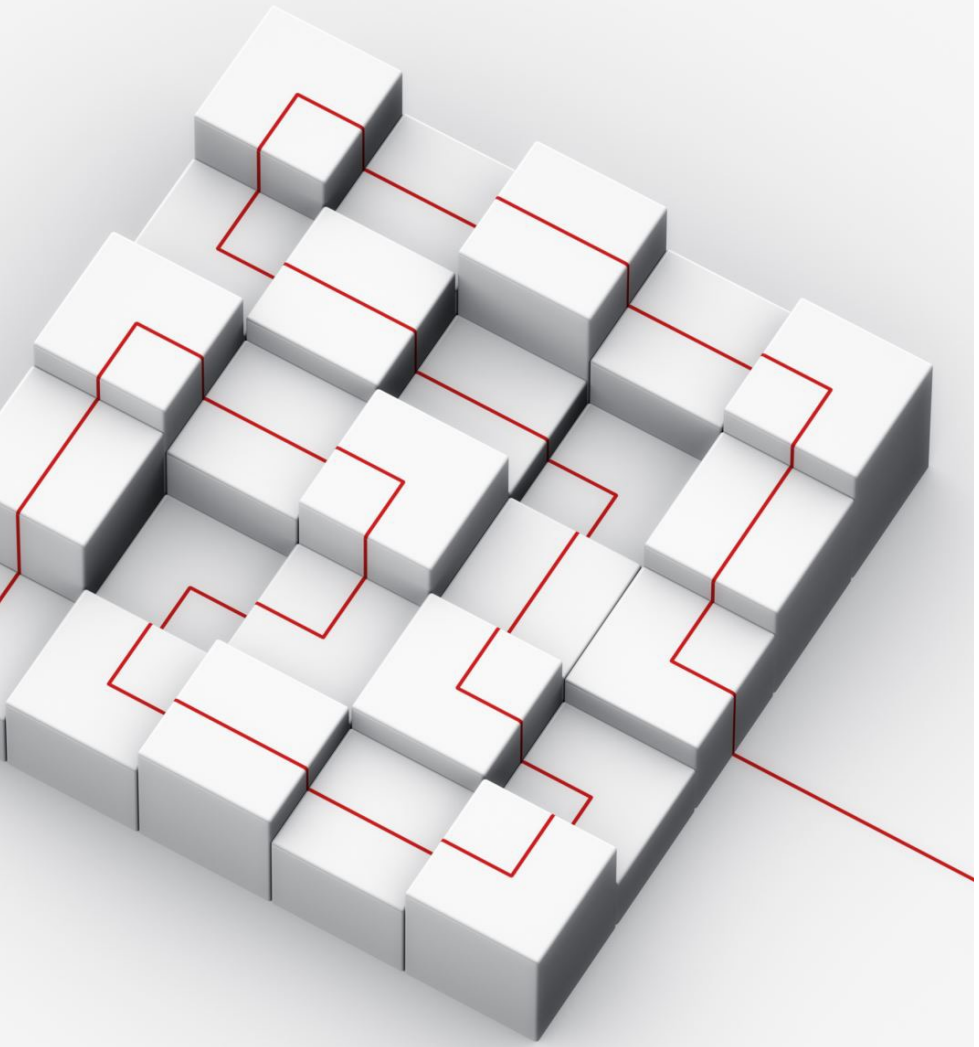
http://www.nytimes.com/interactive/2012/06/19/science/0619-microbiome.html?_r=1&

Species



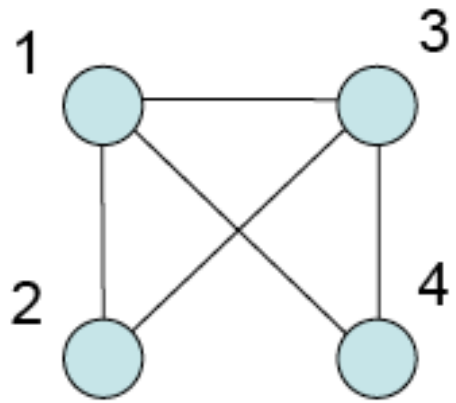
http://tolweb.org/tree/

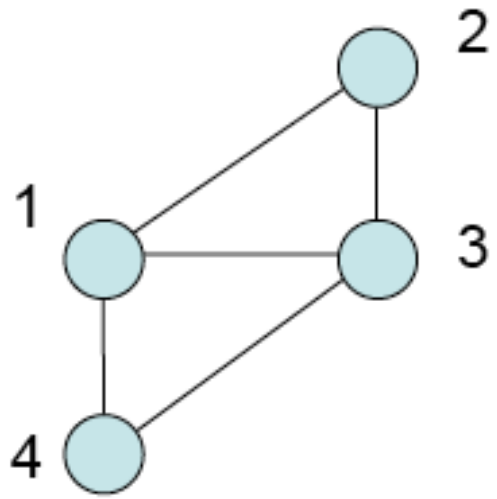
http://www2.research.att.com/~yifanhu/TOL/

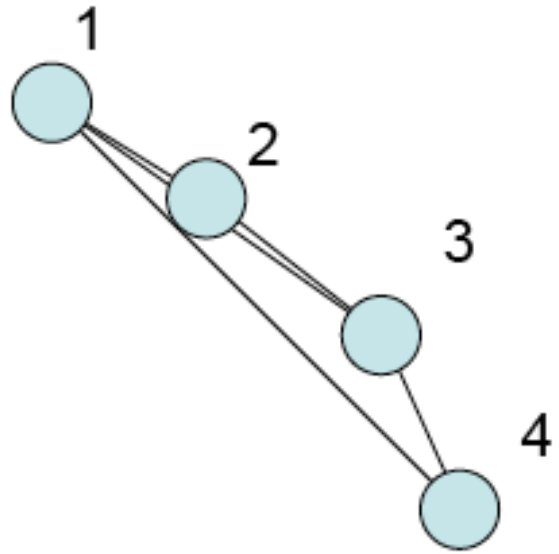


Hierarchical Data Visualization

- Node-link diagram (structure-clarity).
  - Node-link tree.
  - Hyperbolic tree.
  - Cone tree.
- Space-filling methods (space-efficiency).
  - Treemap.
  - Voronoi treemap.
- Hybrids.

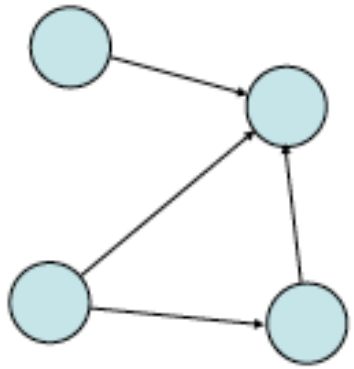




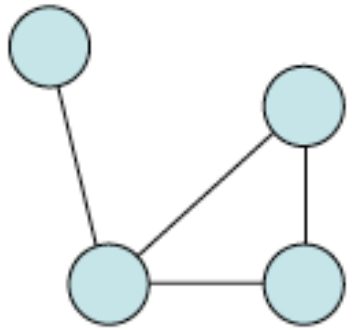


Prerequisite— Basics of Graph Theory

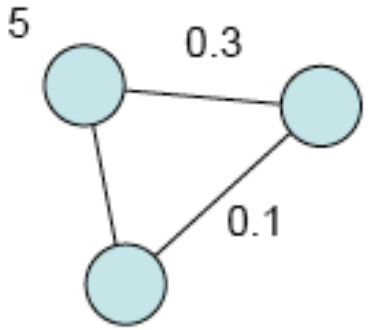
- Graph G is composed of a vertex set *V* and an edge set *E*.
- Every edge $E_{xy} = (x, y)$ connects two vertices *x* and *y*.
- For example:
  - *V*={1,2,3,4}, *E*={(1,2),(1,3),(2,3),(3,4),(4,1)}



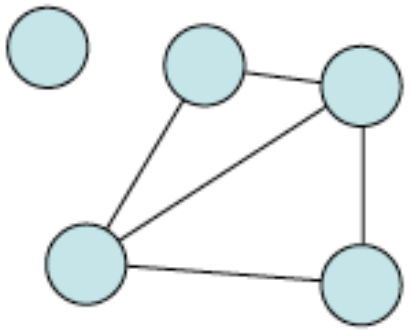
A directed graph



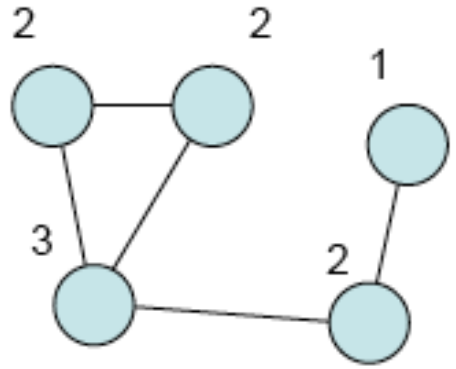
An undirected graph



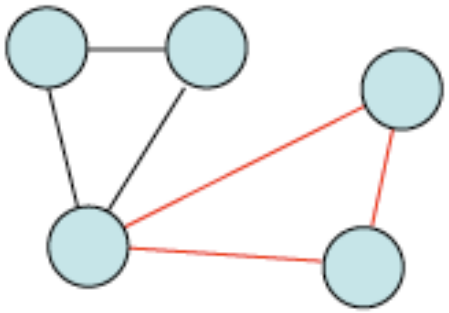
Weighted



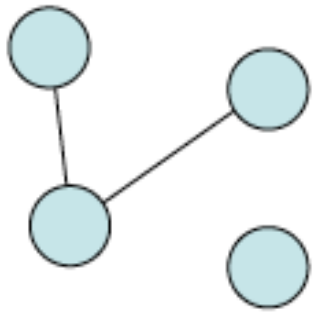
Unconnected



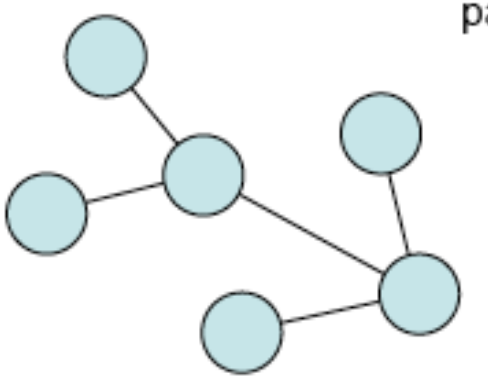
Node degrees



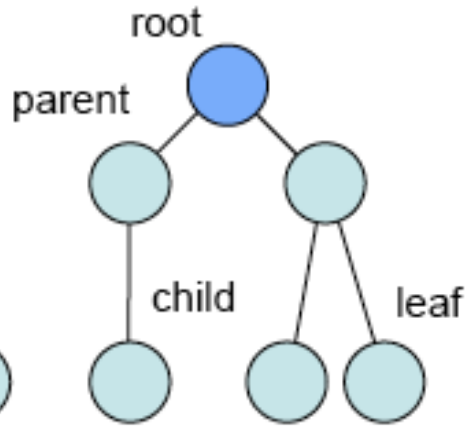
A cycle



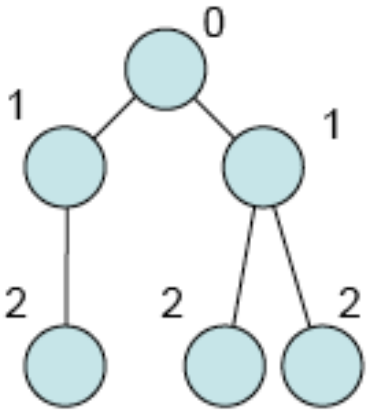
An acyclic graph



A connected acyclic graph, a.k.a. a **tree**



A rooted tree or hierarchy

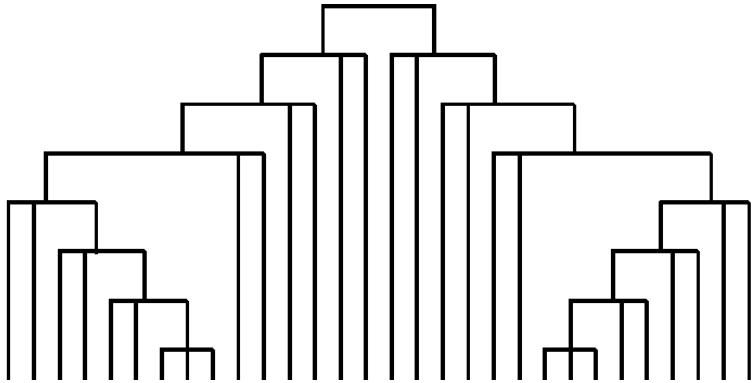


Node depths

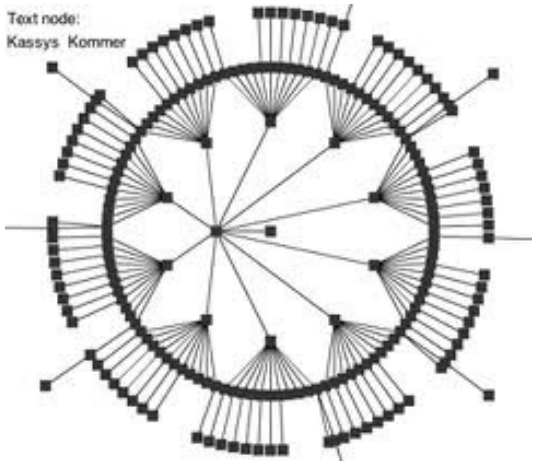
Layout of Nodes and Links

- Orthogonal layout.
  - Circuits diagram.
  - Indent diagram.
  - Dendrogram diagram.

- Radial layout.
  - Radial layout.
  - Hyperbolic tree.



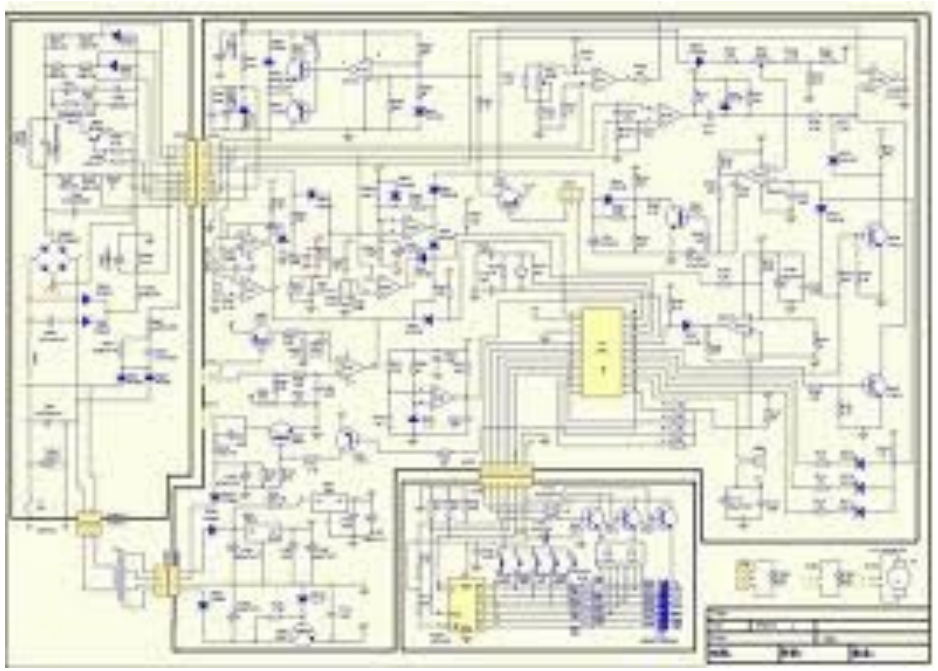
Dendrogram



Radial layout

Circuits Diagram

- Orthogonal and space efficient.
- Computer friendly, but not user friendly.

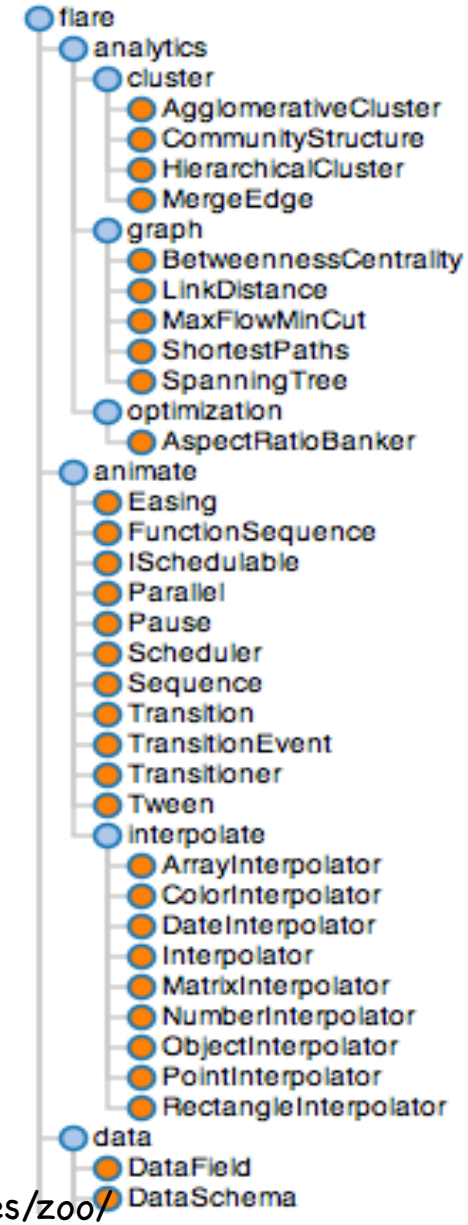


Circuits diagram of induction cooker

Indent Diagram

- Easy to implement.
- Can be applied to plain text or HTML.
- Much scrolling is needed in big data browsing.
- May lose the context.

```
function draw(node:Node, depth:int) {
    println(<depth spaces> + nodelabel);
    for each child c do
        draw(c,depth+1)
}
draw(root,0);
```



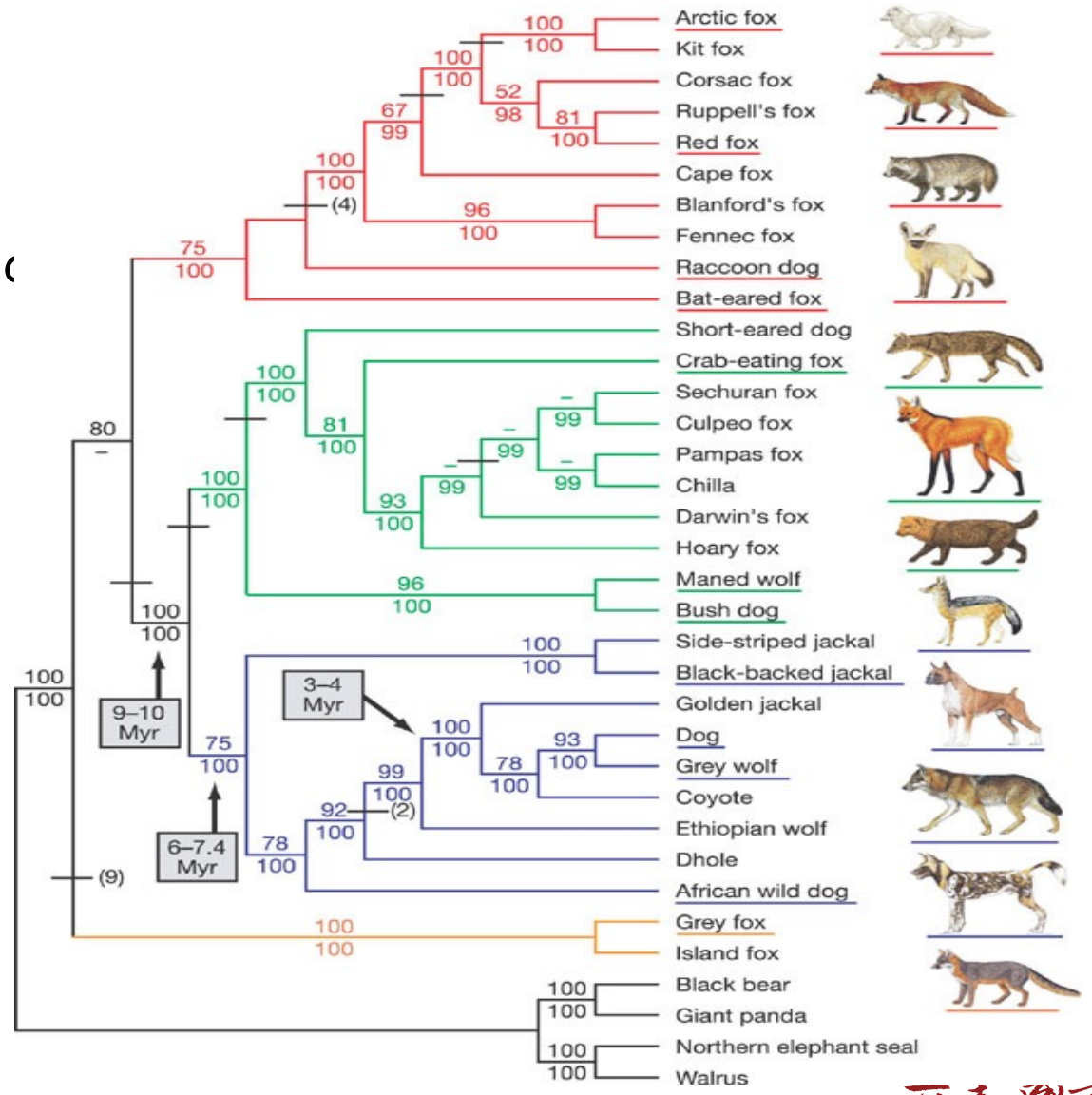
Flare软件包的子目录结构

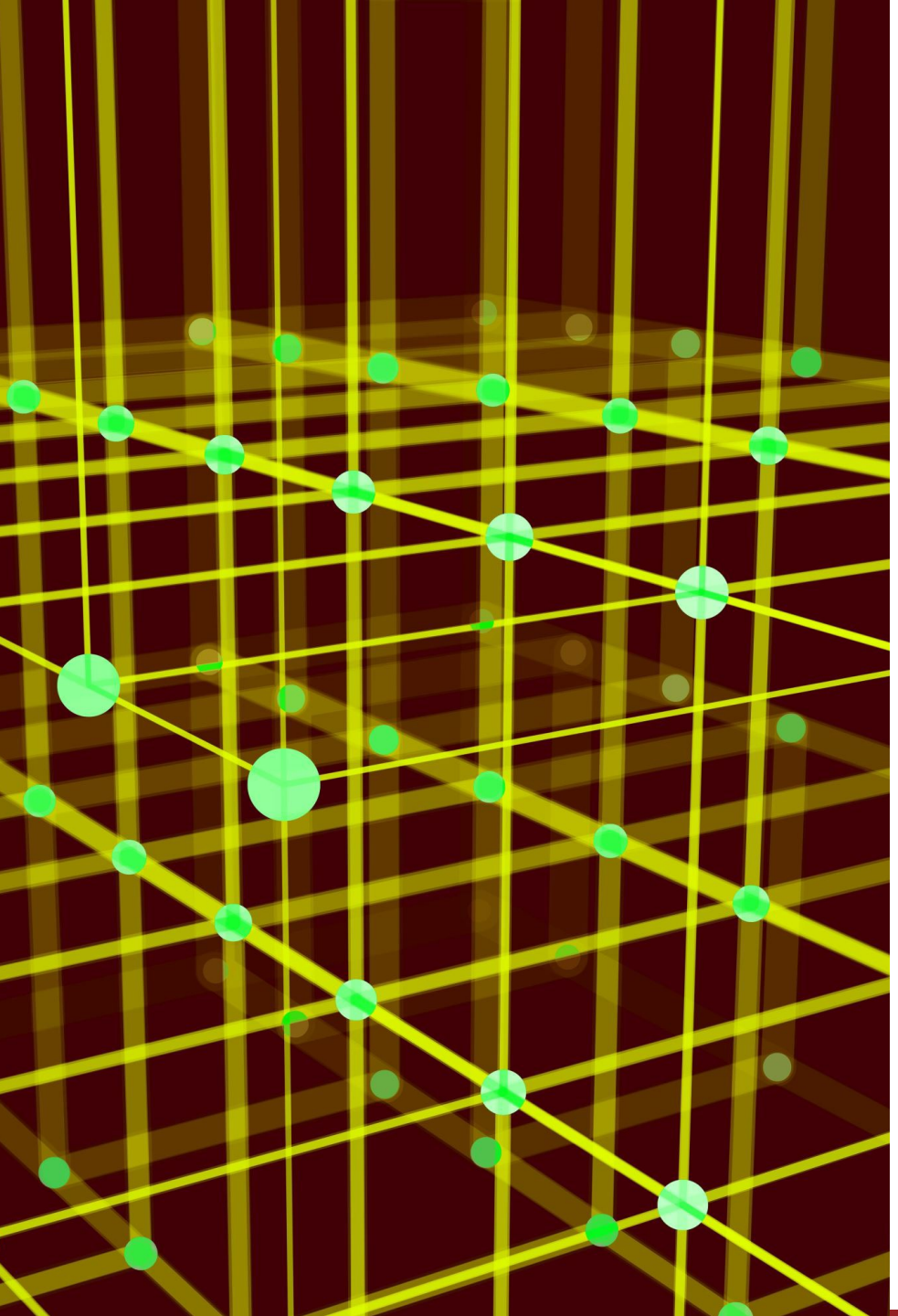
http://hci.stanford.edu/jheer/files/zoo/

Dendrogram

Comparison of dog species' different haploid gene sequenc

Kerstin Lindblad-Toh et al.
Nature 438,
803-819 (8 December 2005)



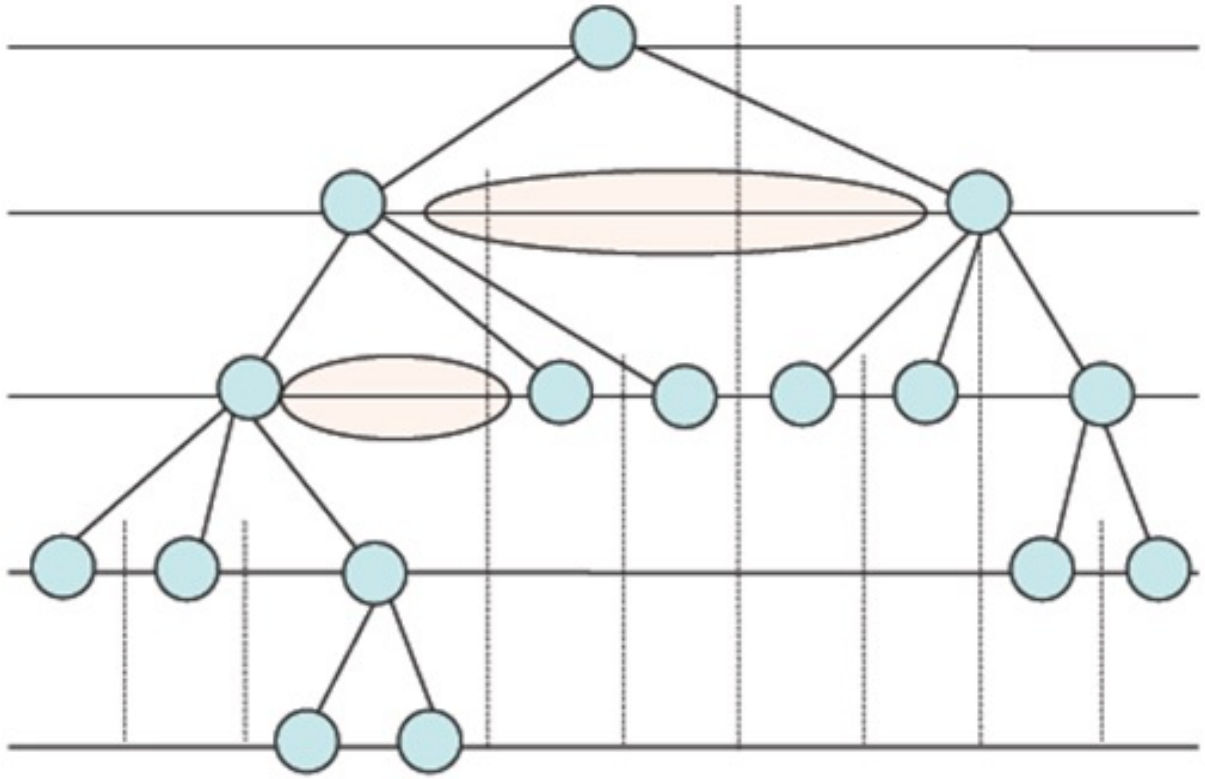


Orthogonal Layout

- Vertices are located either vertically or horizontally.
  - Except circuits diagram.
- Vertices are aligned along axes.
- Drawbacks.
  - Bad aspect ratio.

Implementation of Orthogonal layout

- The simple recursive implementation.



Reingold-Tilford Algorithm

Standards.

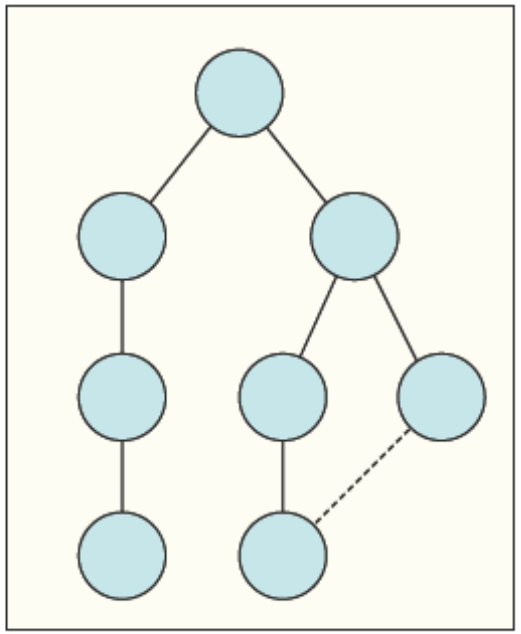
- Rendering according to the layers of nodes.
- Avoiding edge crossing.
- Keep consistency.
- Keep compactness.

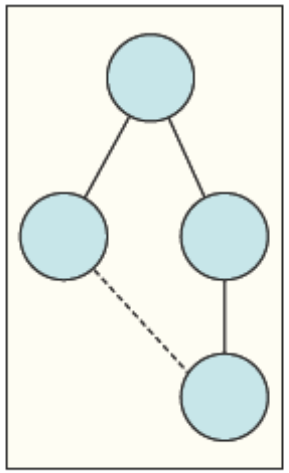
The symmetry and compactness of the layouts

Methods.

- Bottom-up computation.
- Parent node located in the middle of its children.

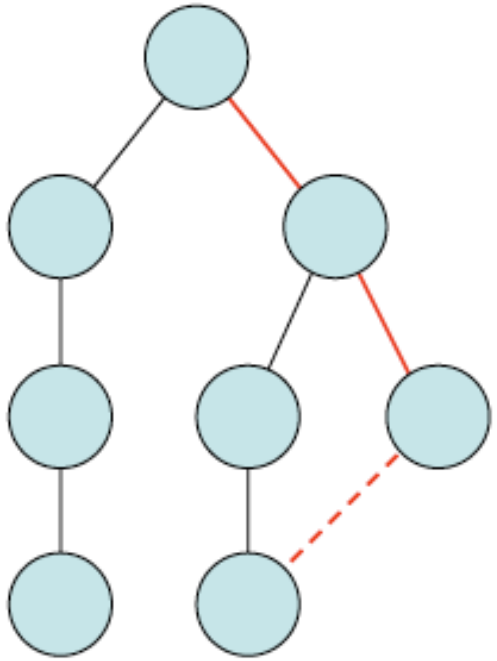
Reingold-Tilford

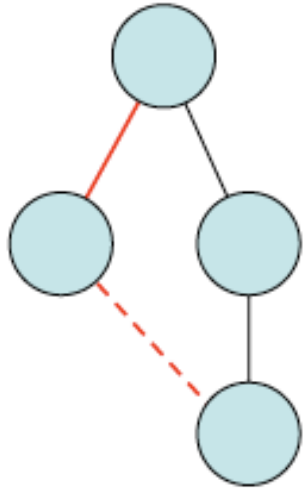




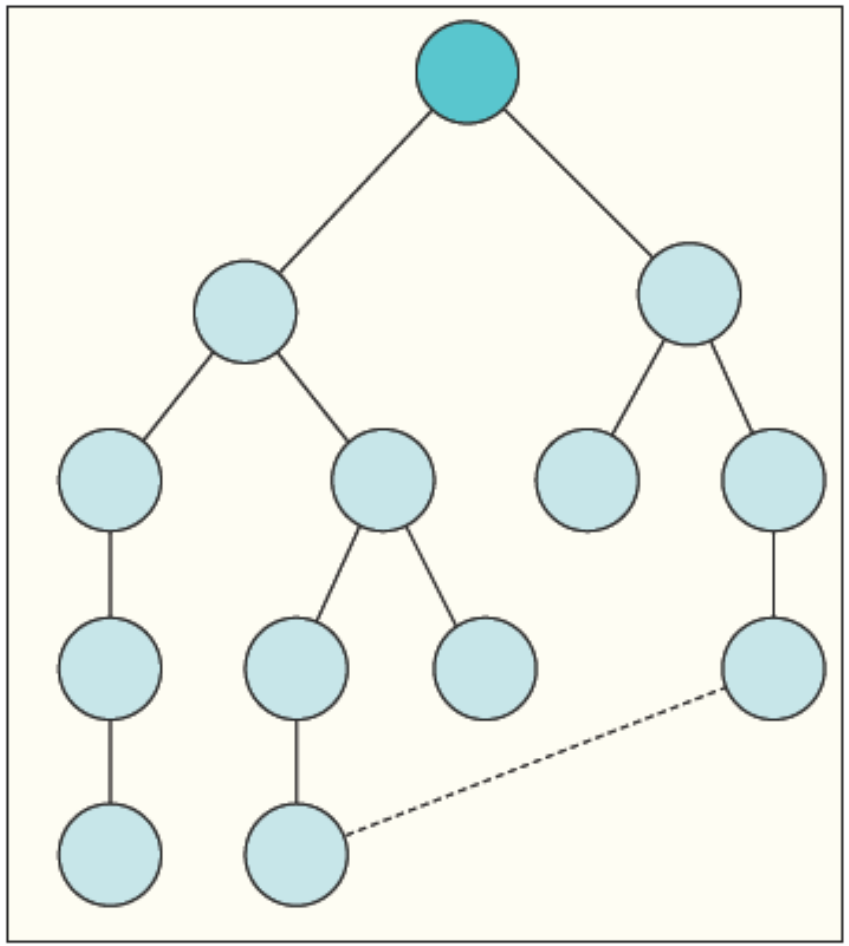
Child branch rendered with RT

Compare the Outline of Its Children And Close Up

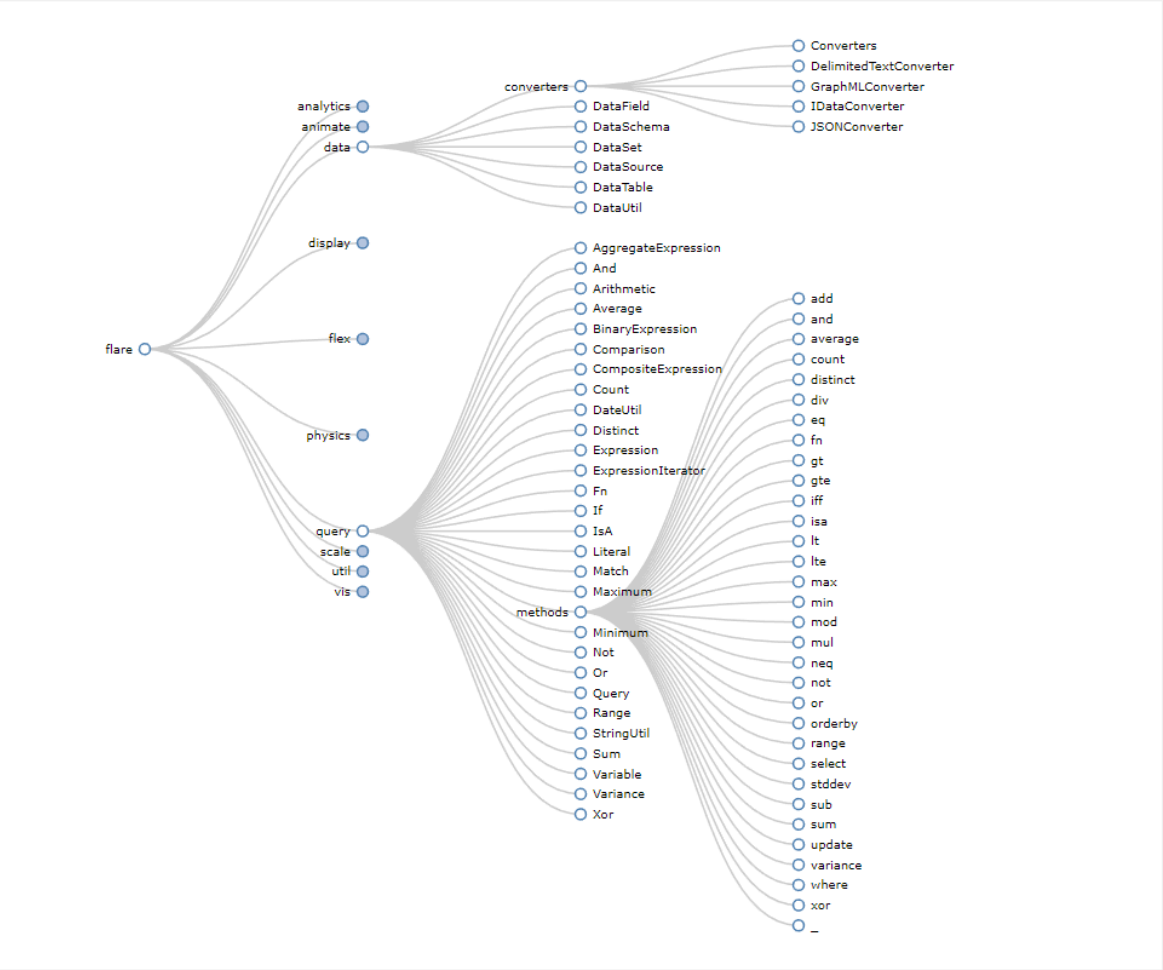




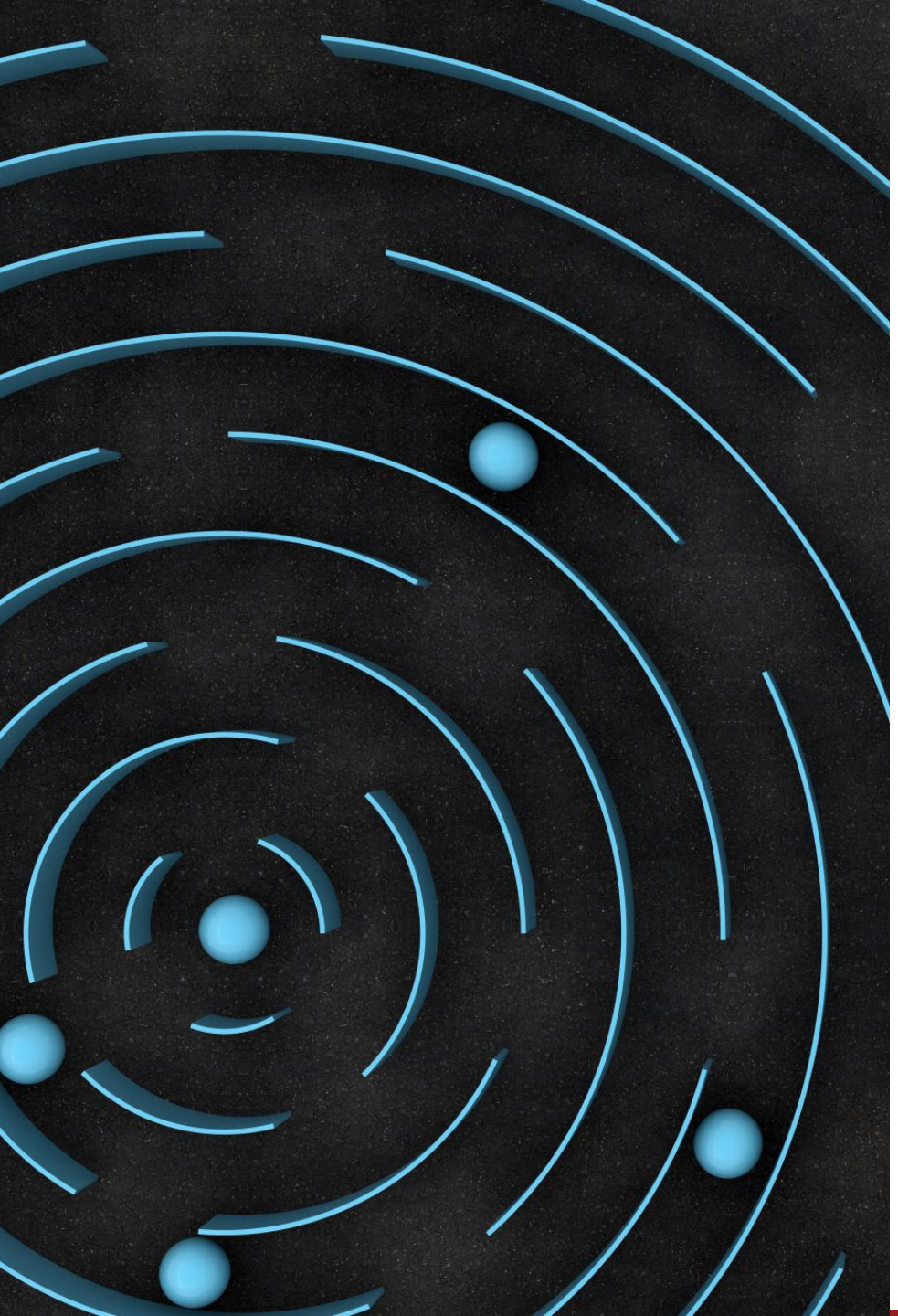
Put Parent In the Middle And Update Children's Positions



Collapsible Tree



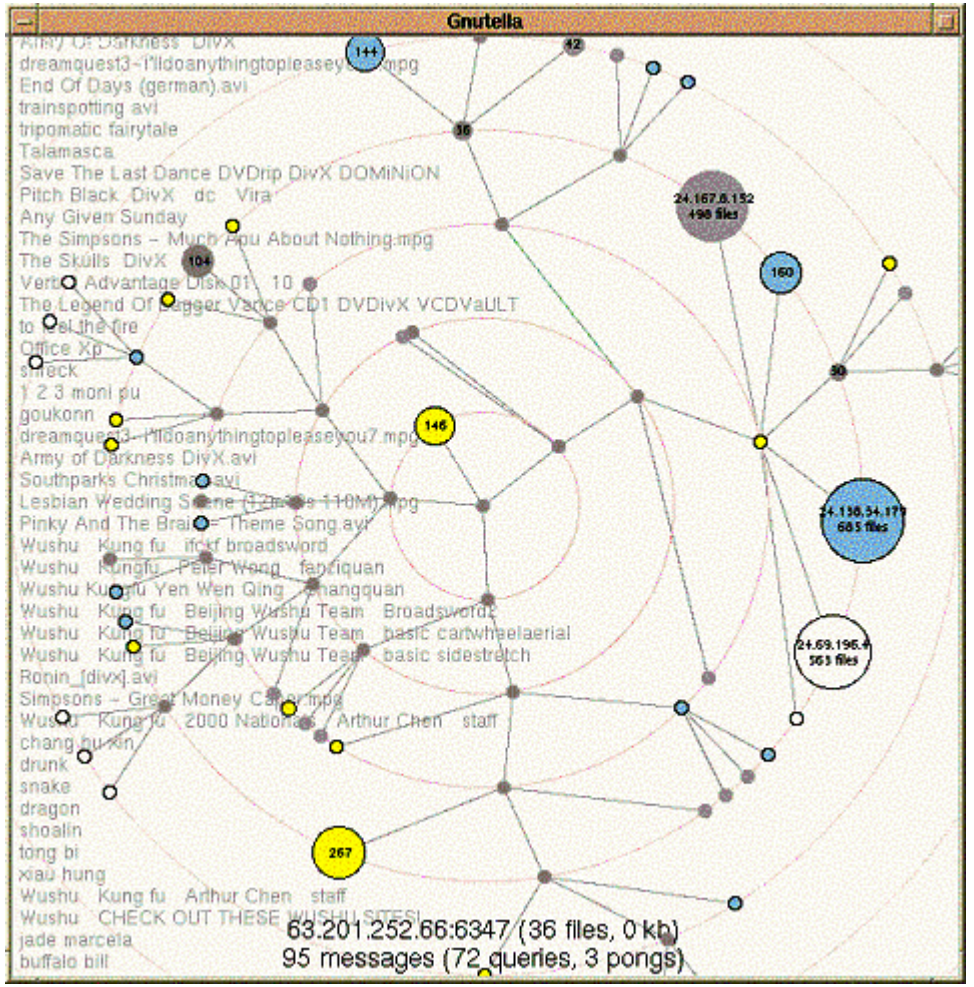
http://bl.ocks.org/mbostock/4339083



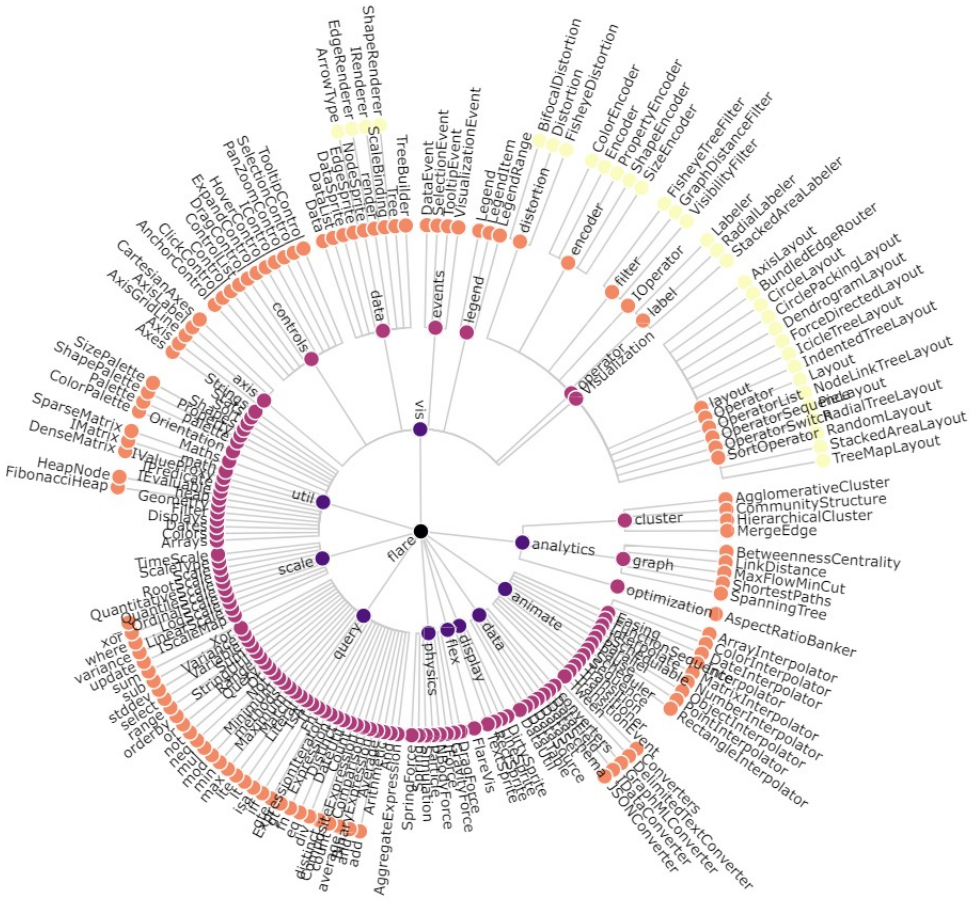
Radial Layout

- Better space utilization.
- Root is at the center of the circle, nodes of different hierarchy located on the circles of different radius.
- Distances to the center is equivalent to the depth of the nodes.
- The deeper, the farther are the nodes to the center, and the more space they will get.

Radial Layout



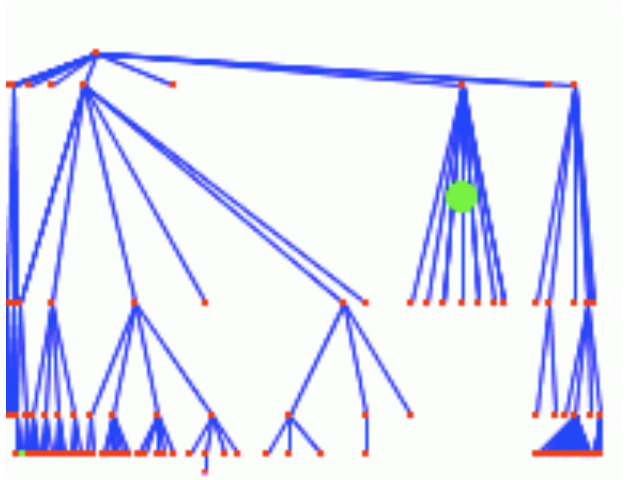
Radial Tree



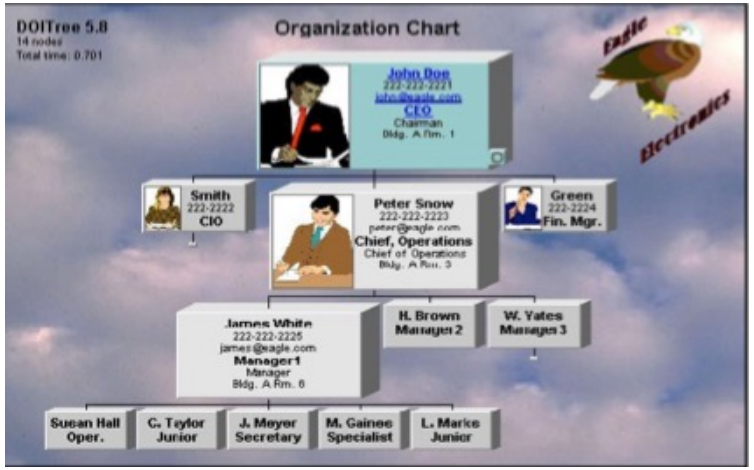
https://vega.github.io/vega/examples/radial-tree-layout/

Problems of Node-link Diagram

- Nodes increase exponentially with the growth of depth.
- Solution—Interaction.
  - Distortion.
  - Filtering.



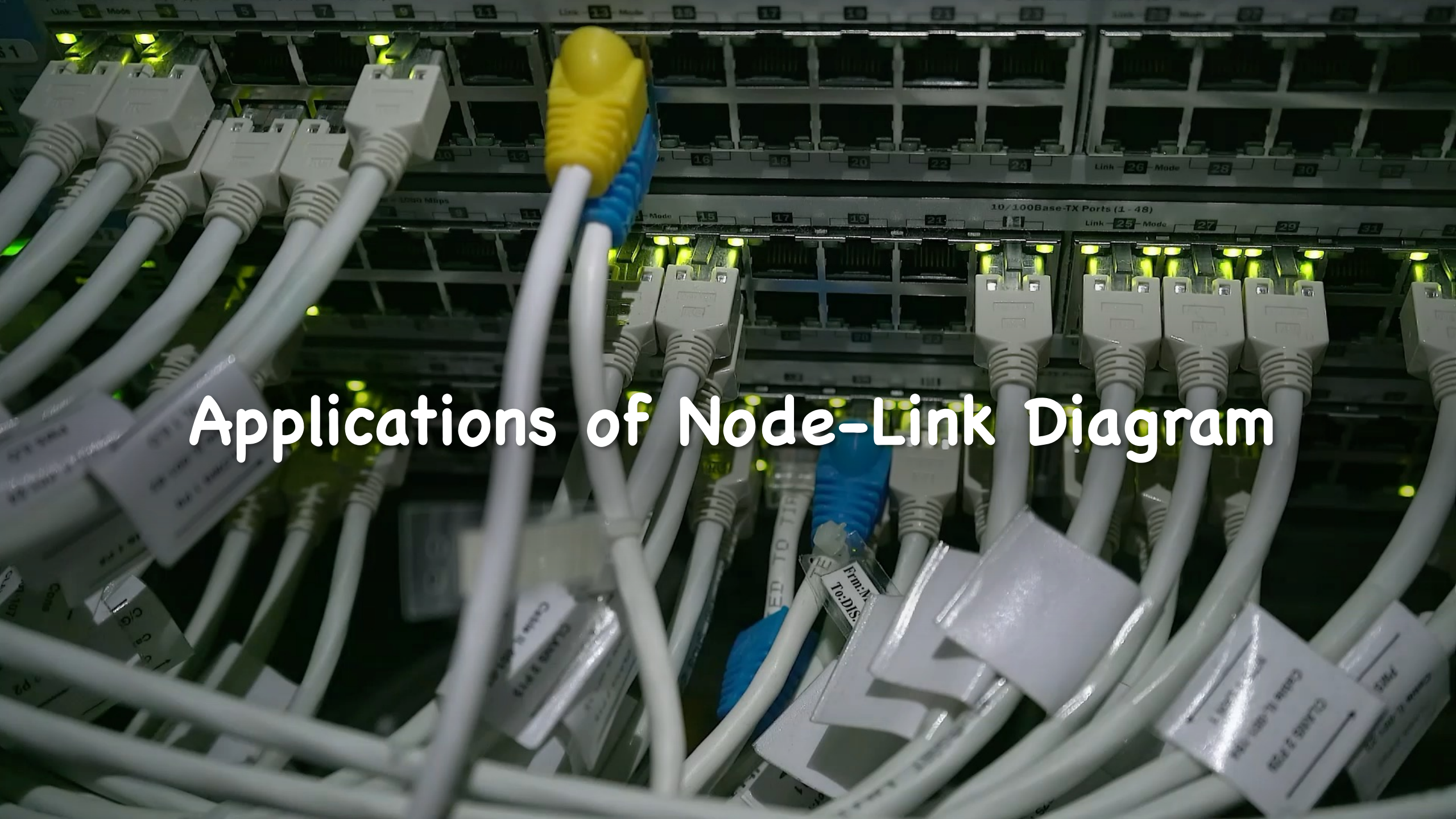
Fisheye distortion



DOI tree (filtering)

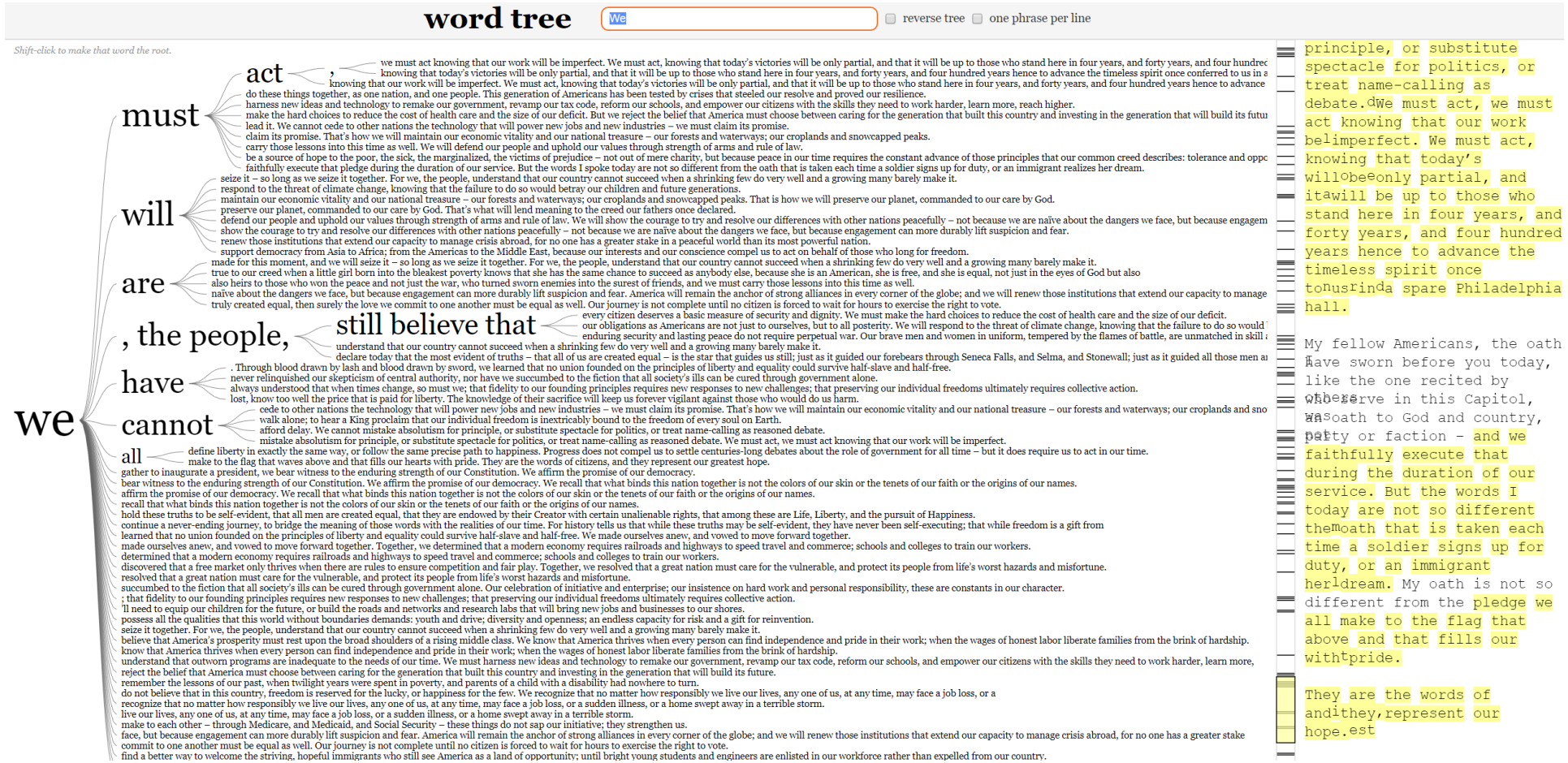
Visual Requirements

- Key idea: to present the relationship among nodes clearly and efficiently.
  - Order of nodes follow their hierarchies.
  - Less edge crossing.
  - Shorten edge length.
  - Be aware of the aspect ratio.



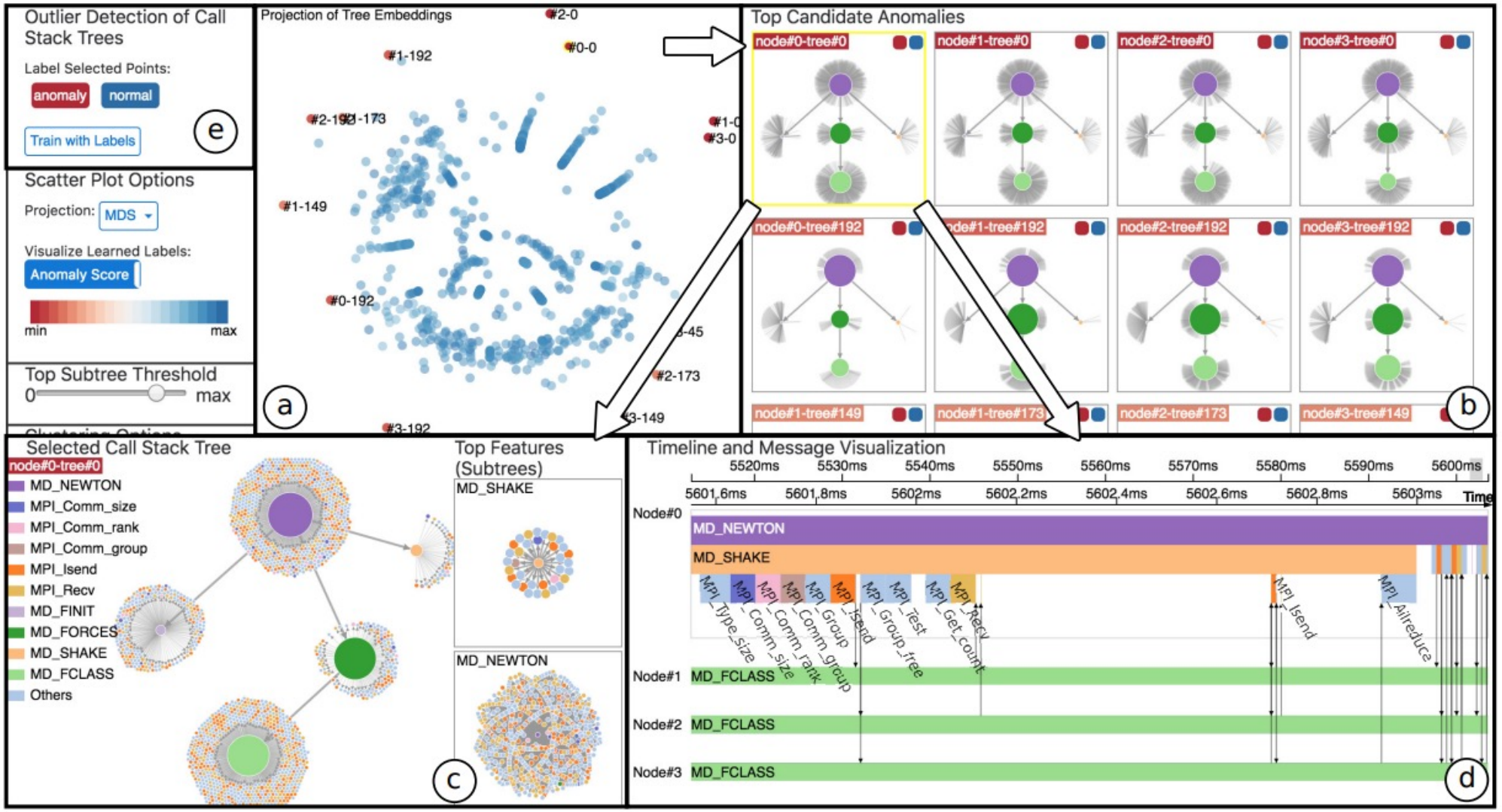
Applications of Node-Link Diagram

Word Tree



https://www.jasondavies.com/wordtree/

Call Stack Tree



Xie et al. A Visual Analytics Framework for the Detection of Anomalous Call Stack Trees in High Performance Computing Applications (IEEE VAST 2018).

VAST PAPER

A Visual Analytics Framework for the Detection of Anomalous Call Stack Trees in High Performance Computing Applications

Cong Xie, Wei Xu, Klaus Mueller

VIS 2018
21 – 26 October 2018
Berlin, Germany
ieeevis.org

visualization design lab
CALEYDO

Juniper: A Tree+Table Approach to Multivariate Graph Visualization

Carolina Nobre, Marc Streit, and Alexander Lex

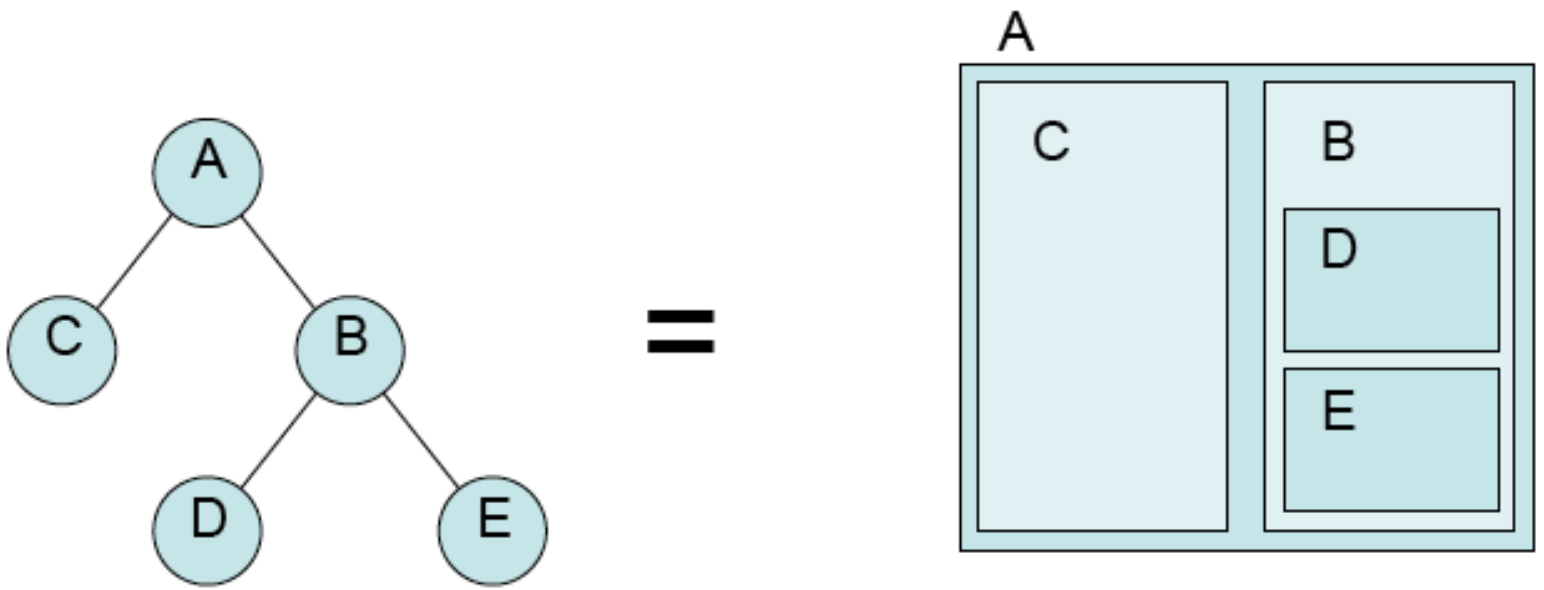
THE UNIVERSITY OF UTAH
JOHANNES KEPLER UNIVERSITY LINZ

Nobre et al. Juniper: A Tree + Table Approach to Multivariate Graph Visualization (IEEE InfoVis 2018).


Space-Filling Methods

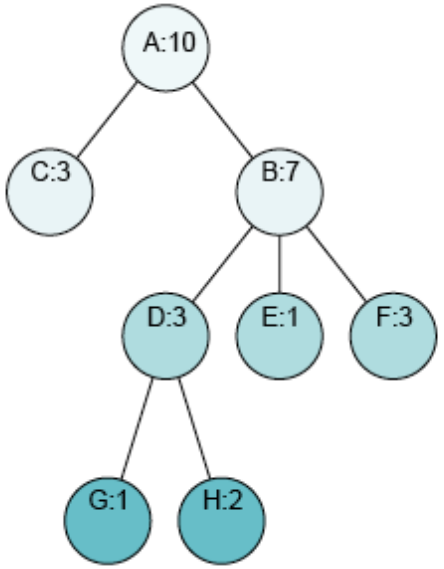
Enclosure

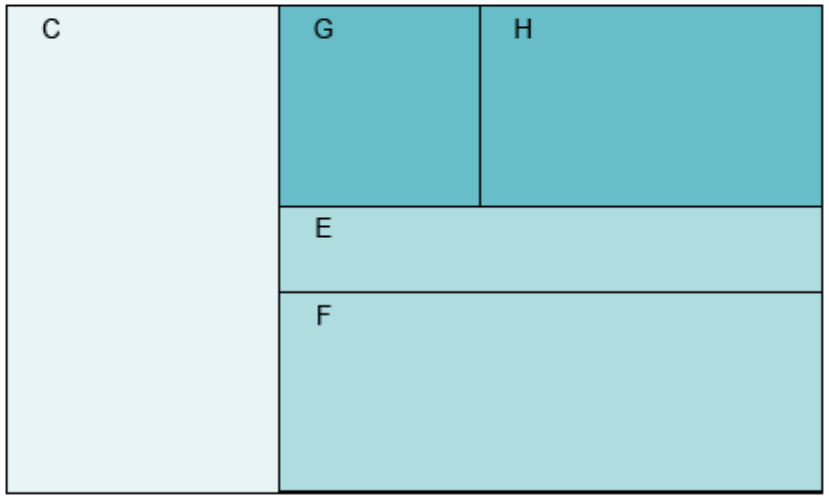
- Child nodes are nested in parent nodes.



Treemap

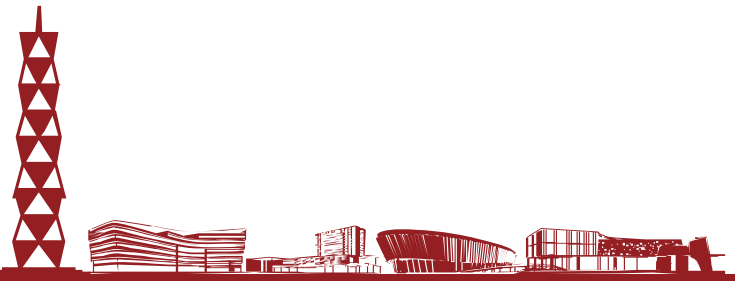
- Assume that each leaf node has a size-related attribute (size of the file...).
- Size of parent nodes is the sum of his children's.





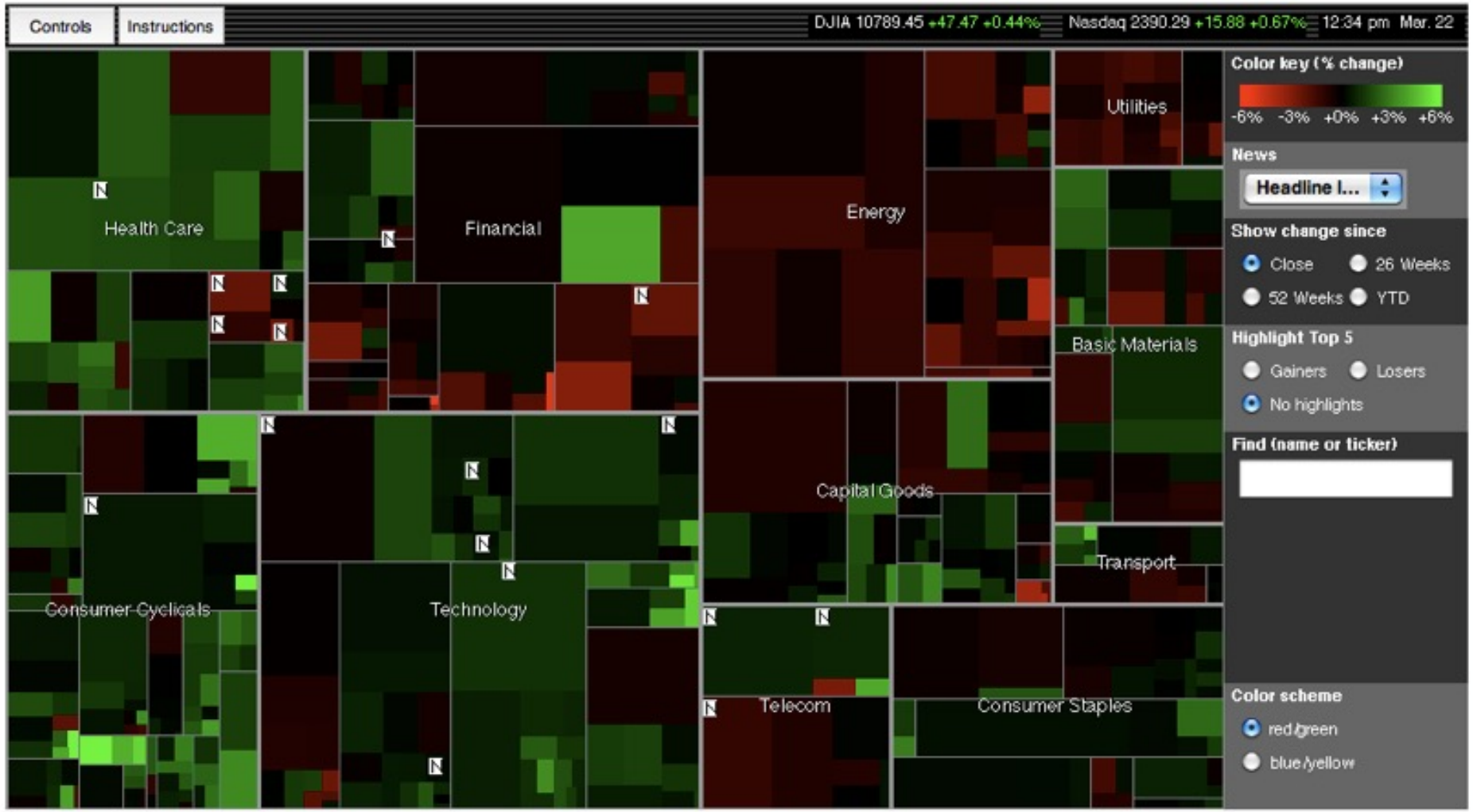
Treemap

- Johnson and Shneiderman raised the slice-and-dice Treemap in 1991.
- Layout method:
  - Recursive subdivision.
  - Root is the largest rectangle.
  - Size of child nodes are assigned according to their weights.
  - Subdivide child nodes.



Map of the Market

Launch Map in Separate Window



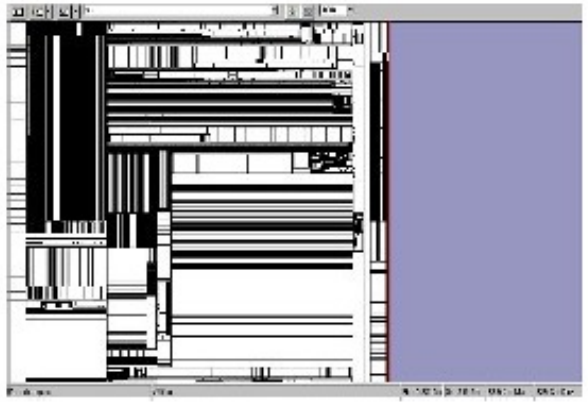
MARKET NEWS

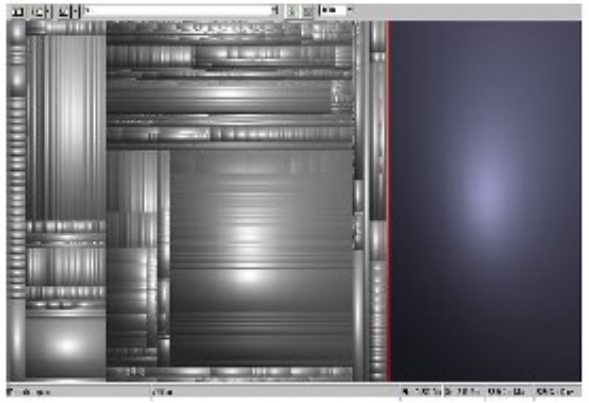
- President Obama Hails Passage of Health Care Bill
- Health Bill Taxes Drug, Device Makers and the Rich
- Stock Screen: 3 Stocks With Big Dividends and Buybacks

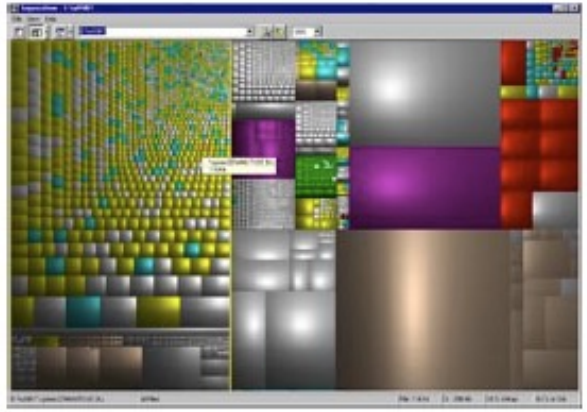
Patent No.: US 6,583,794 B1

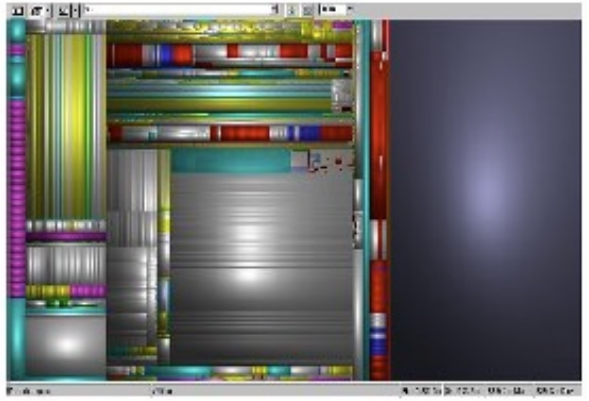
Click Here to License the Map Applet

Disk Browser





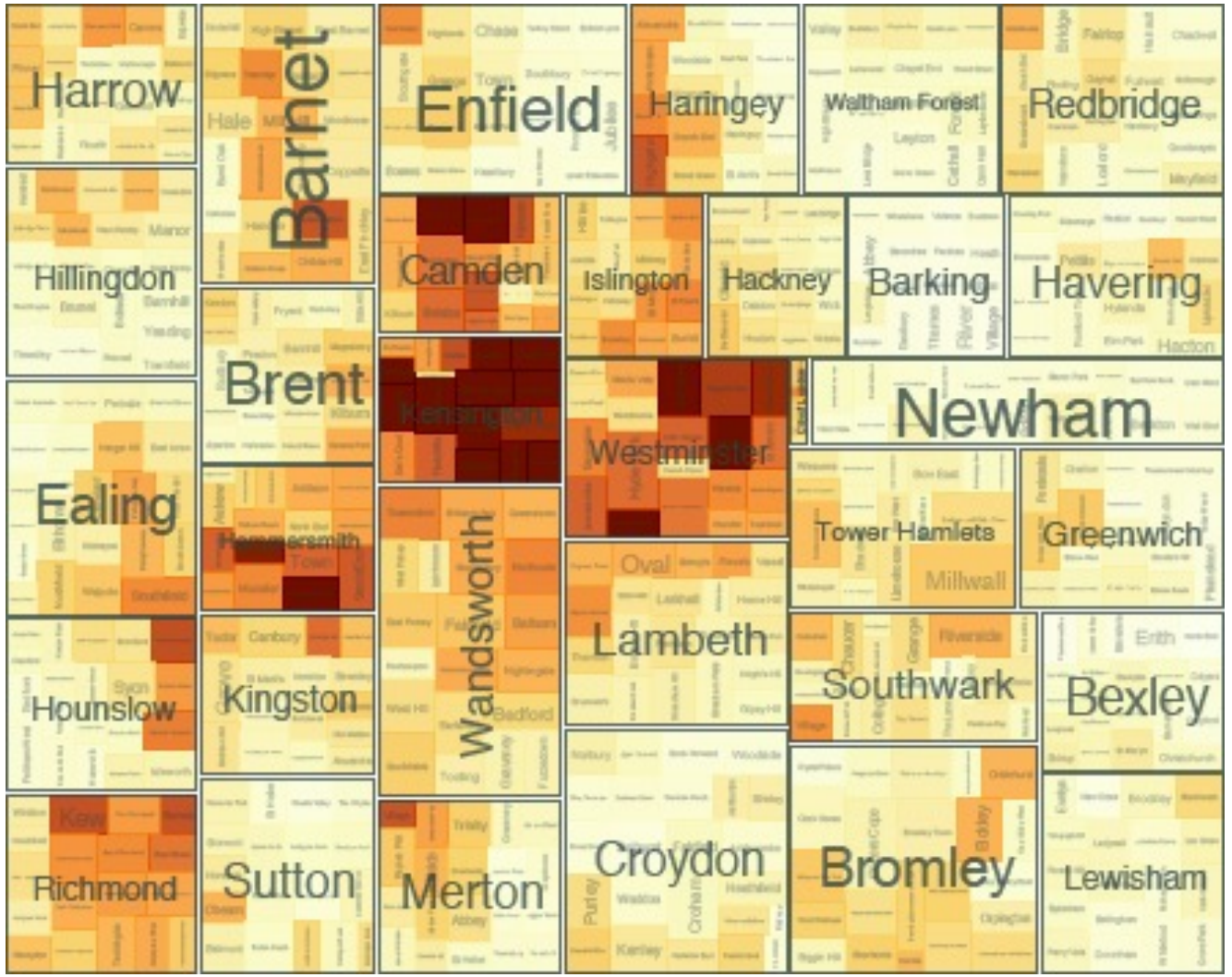




http://w3.win.tue.nl/nl/onderzoek/onderzoek_informatica/visualization/sequoiaview/

Treemap of Categorical Data

- London personal housing transactions.

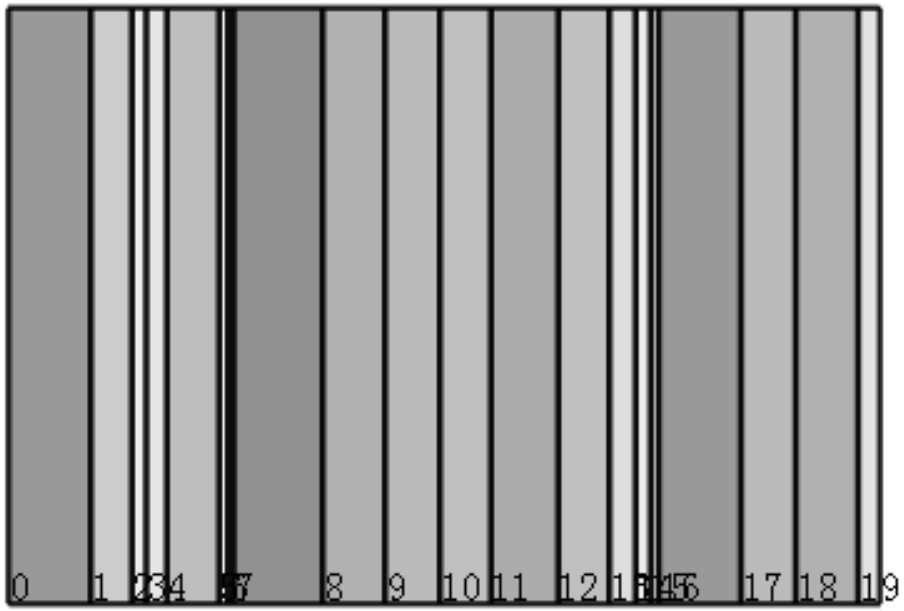


Hierarchy of Categorical Data

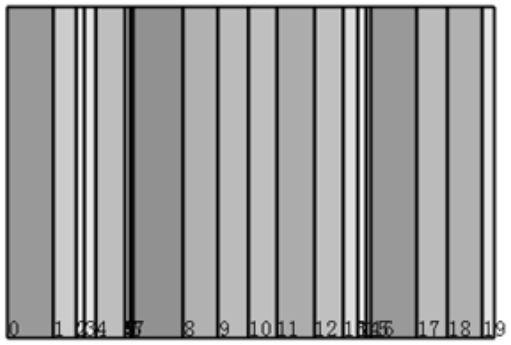
- No hierarchy among categories.
- Different hierarchy assignment results in huge difference, even misleading.
- Dominant categories should be parent nodes.
- Housing transaction data.
  - District: downtown, suburbs.
  - Type of the house: villa, apartment.
  - Neighborhood.

Problems of Treemap

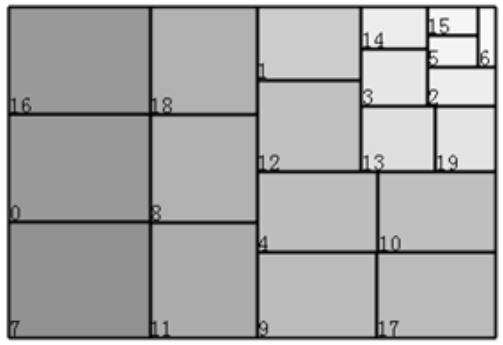
- Simple slice-and-dice subdivision method results in thin and long rectangles.
- It would be difficult to interact with nodes.



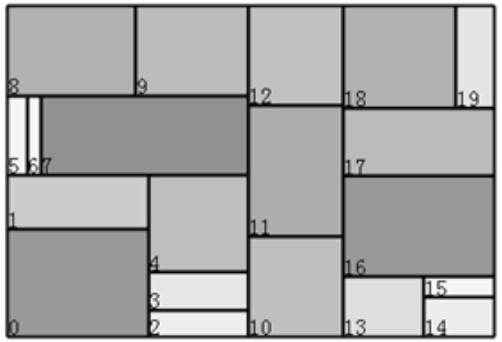
Extensions of treemap



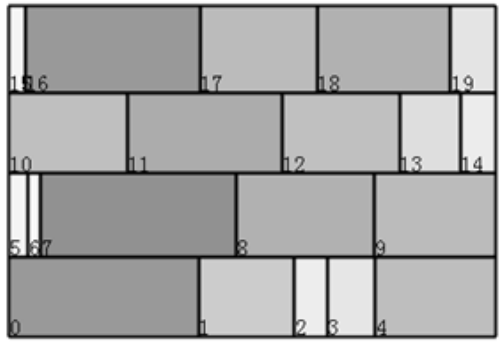
Slice-and-dice



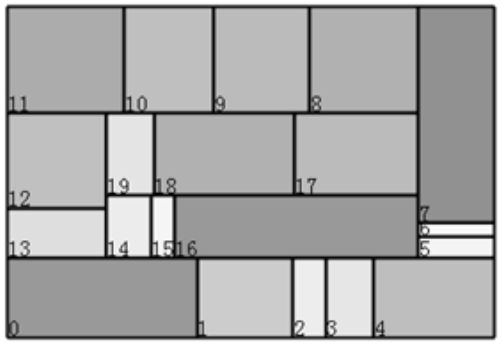
Squarified



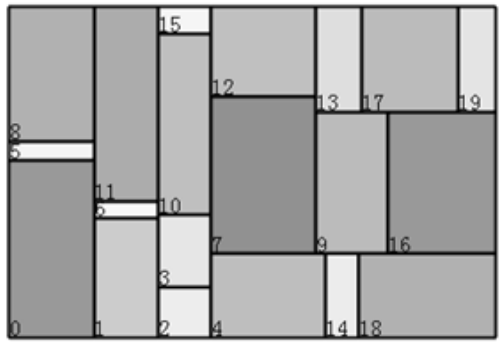
Ordered



Strip



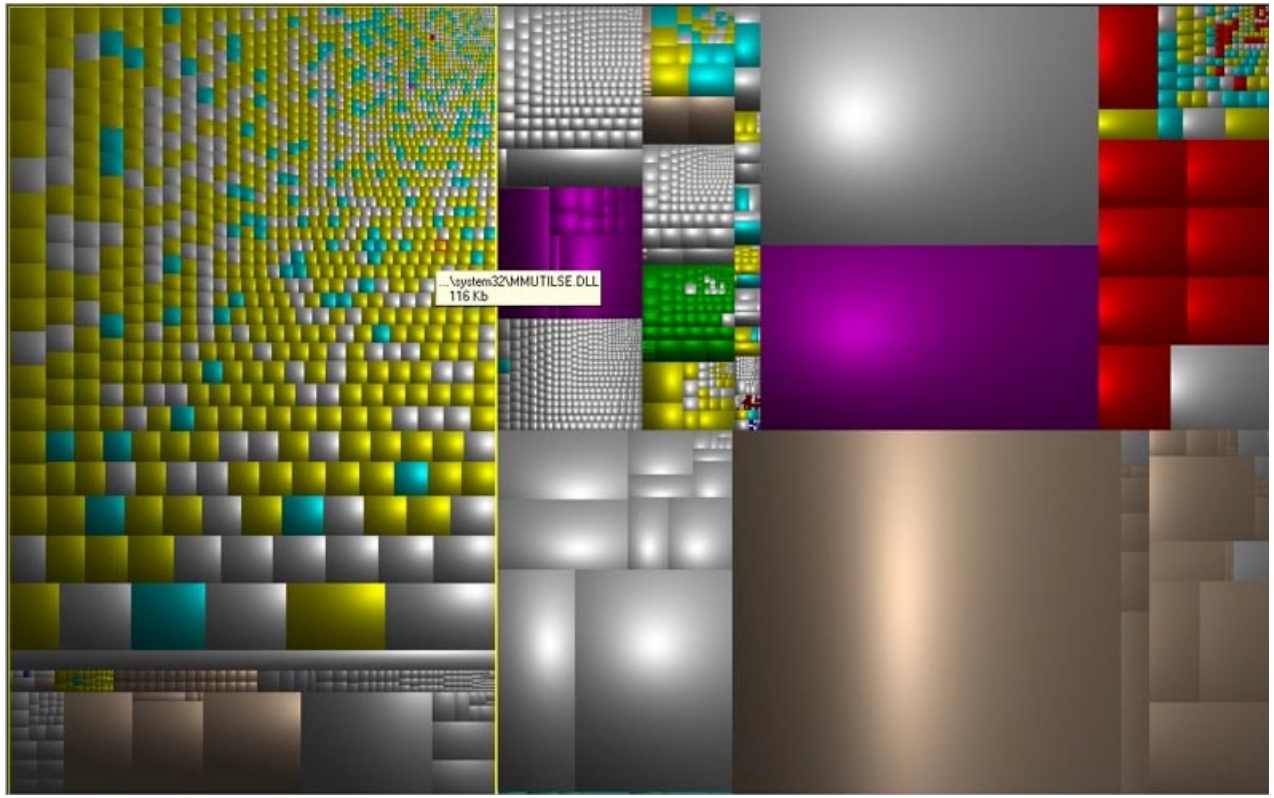
Spiral



Ordered Squarified

Cushion Treemap

- Simulation of 3D object lighting.



Cushion Treemap in SequoiaView

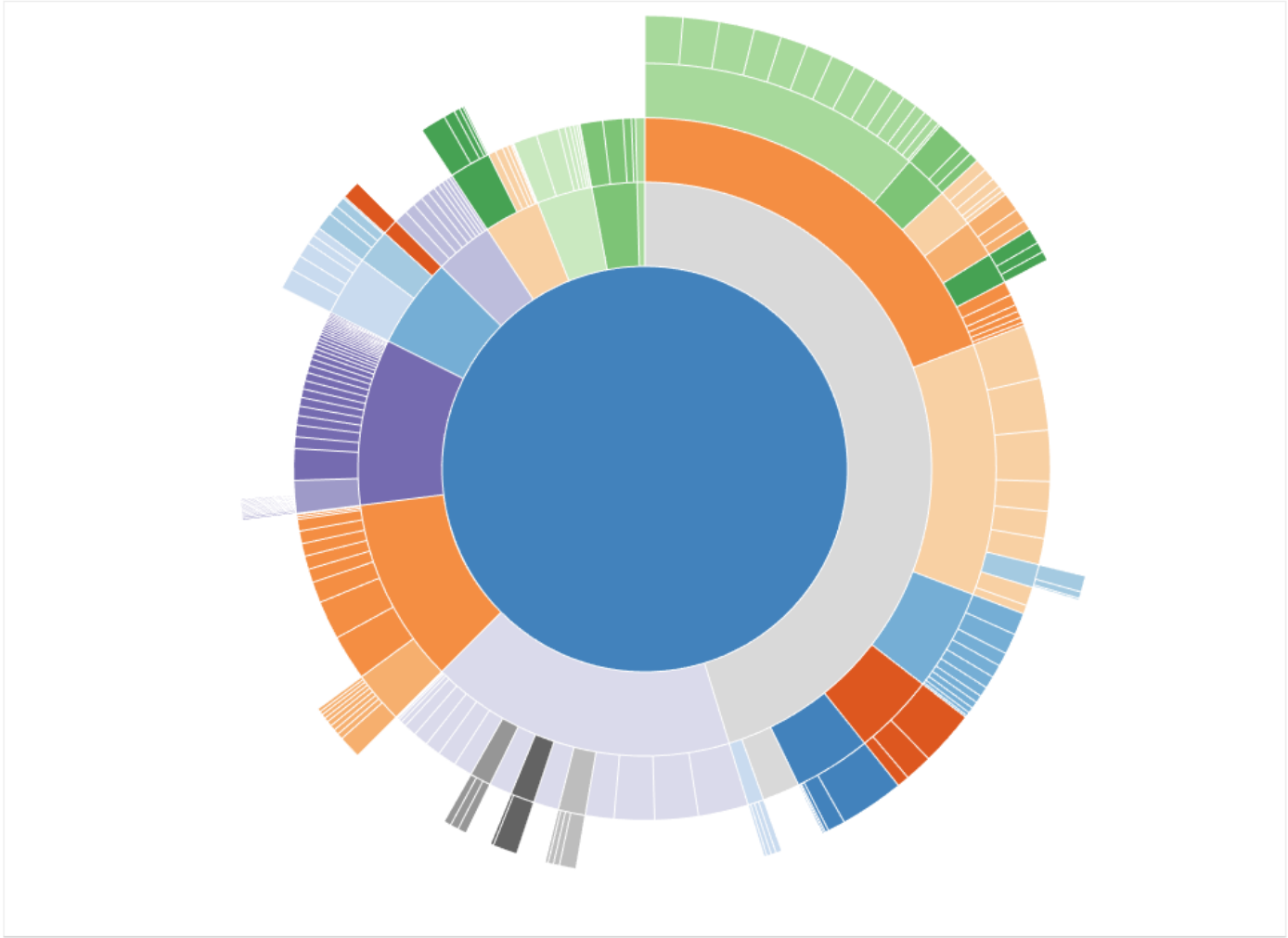
Shneiderman B. Discovering Business Intelligence Using Treemap Visualizations.
http://www.b-eye-network.com/print/2673

Treemap Layout Algorithms	Ideas	Aspect Ratios	stability	readability	Continuity	Balance of stability	Distance relavance
Slice-and-dice	Subdividing either horizontally or vertically alternatively	*	***	***	***	***	***
Squarified	Using greedy method to keep optimal aspect ratio	***	*	**	**	**	-
Ordered	Refining iteratively Balance of aspect ratio and readability	**	**	**	**	**	-
Strip	Dividing one strip every time along settled direction	**	**	**	**	**	-
Spiral	Dividing from outside to inside spirally	**	**	**	***	***	-
Ordered Squarified	Estimating the distance to its parent, and locating according to squarified	**	**	*	*	-	***
Spatially Ordered	First roughly locating positions, then using Squarified	**	**	-	-	-	***

Interaction of Treemap

categories	Interactions
Basic interactions	Node selection
	Change of weights
	Assignment and change of color
	Drill down
	Roll up
	Switch of layout algorithm
Novel interactions	MagicLens
	Fisheye
	Semantic Zooming
	Balloon Focus

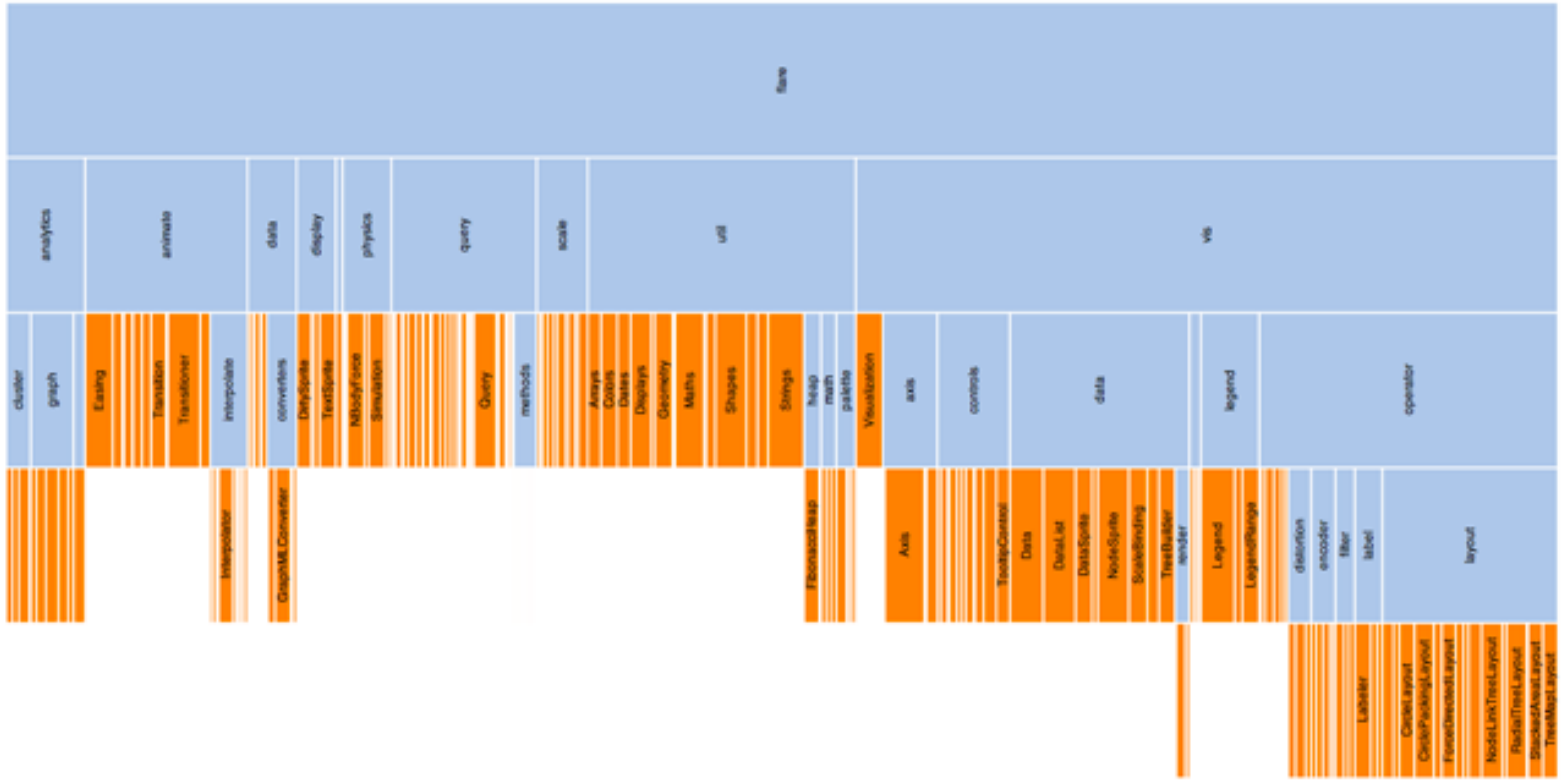
Sunburst Plots



http://bl.ocks.org/mbostock/4348373

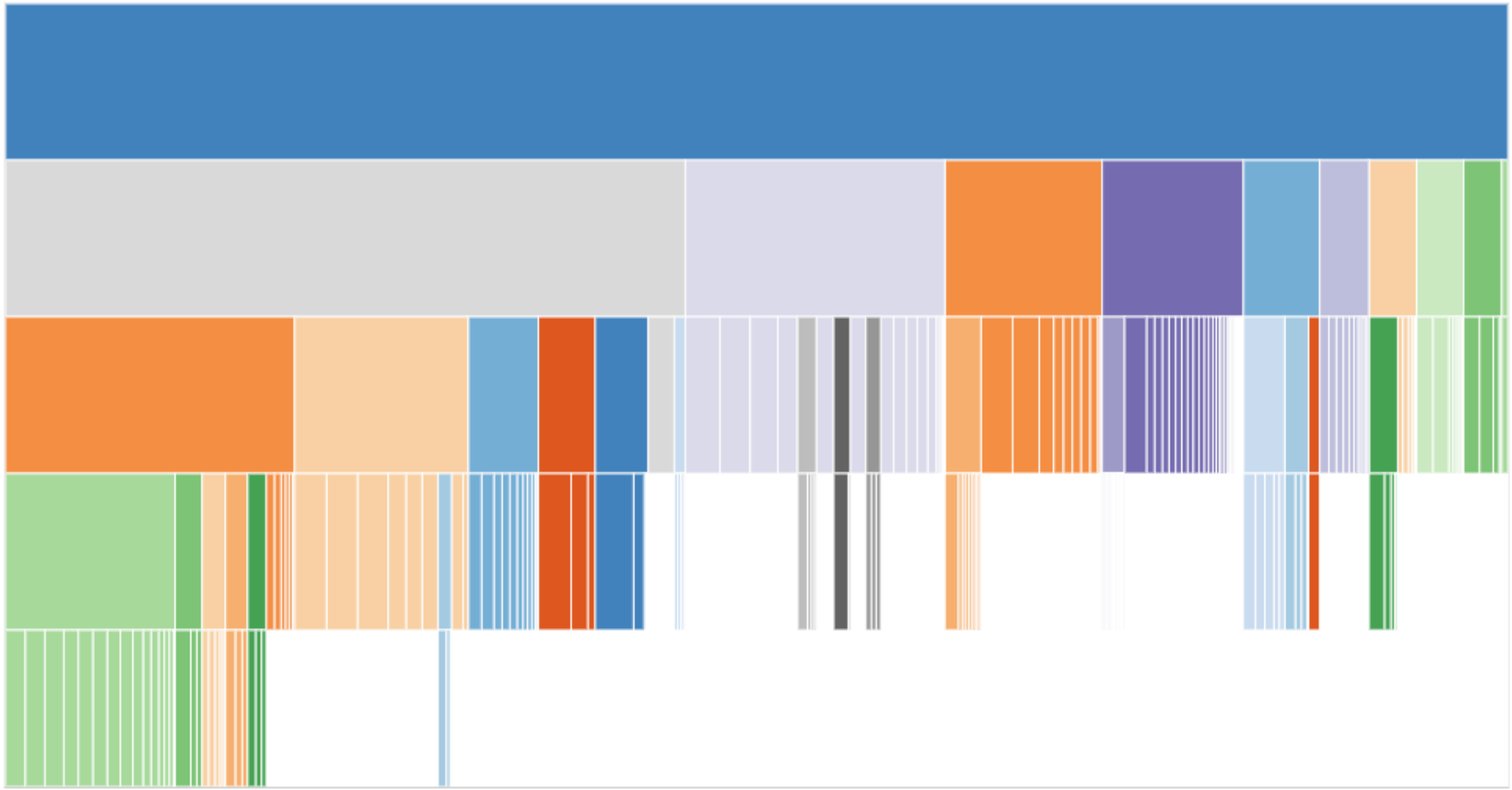
Icicle Diagram

- Used in clustering analysis to represent the results of clustering.



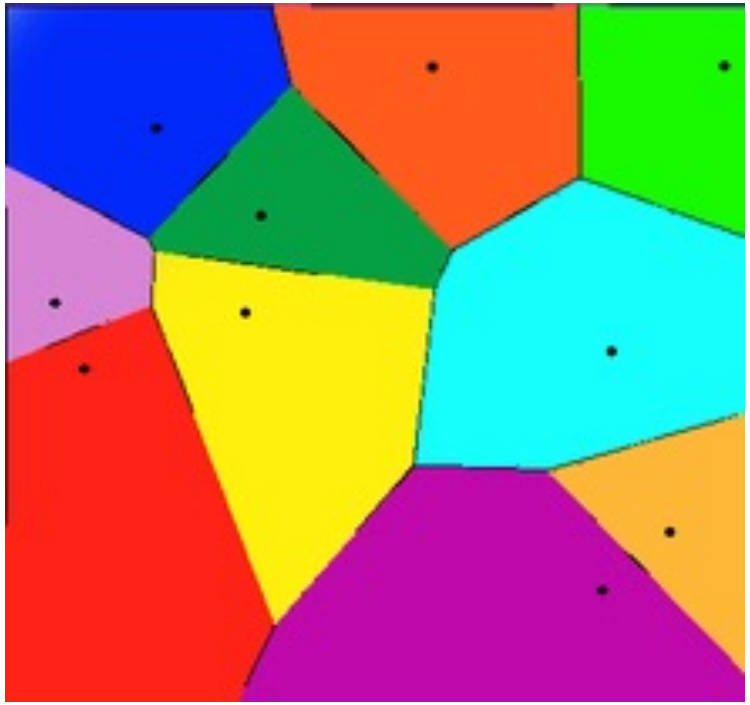
https://hci.stanford.edu/jheer/files/zoo/ex/hierarchies/icicle.png

Icicle Plots



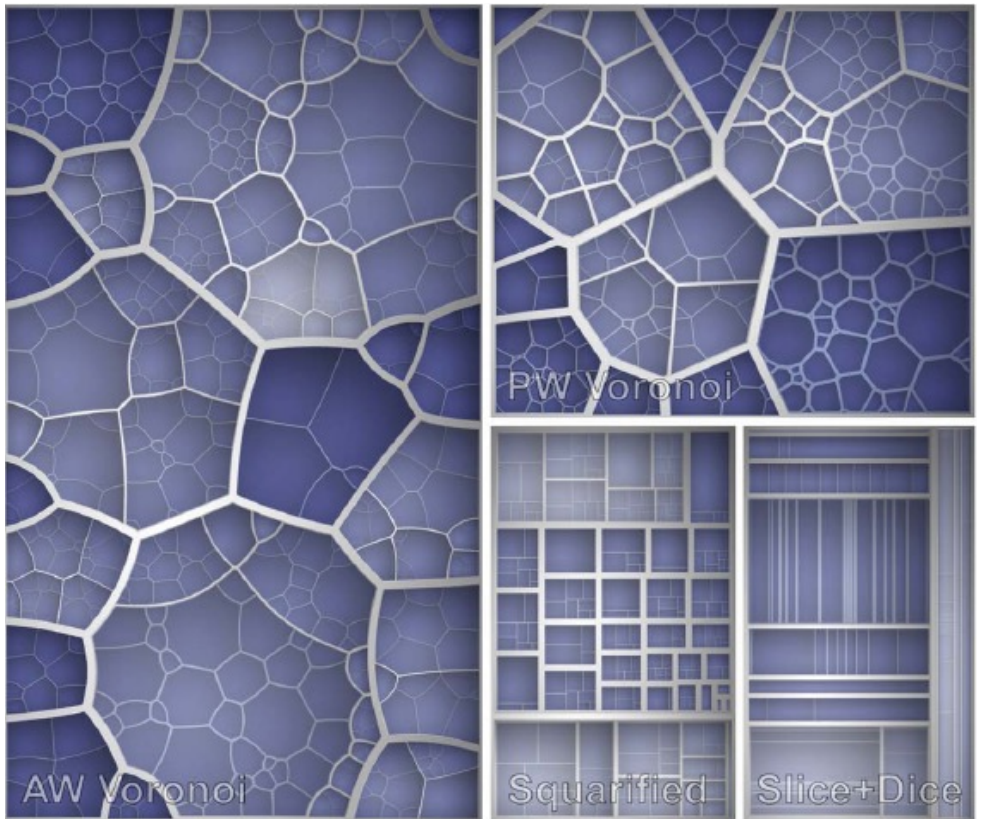
Voronoi Map

- Sphere of influence.
  - Nodes in the sphere are nearer to each other than those outside the sphere.
  - The border of sphere constructs the map.



Voronoi Treemap

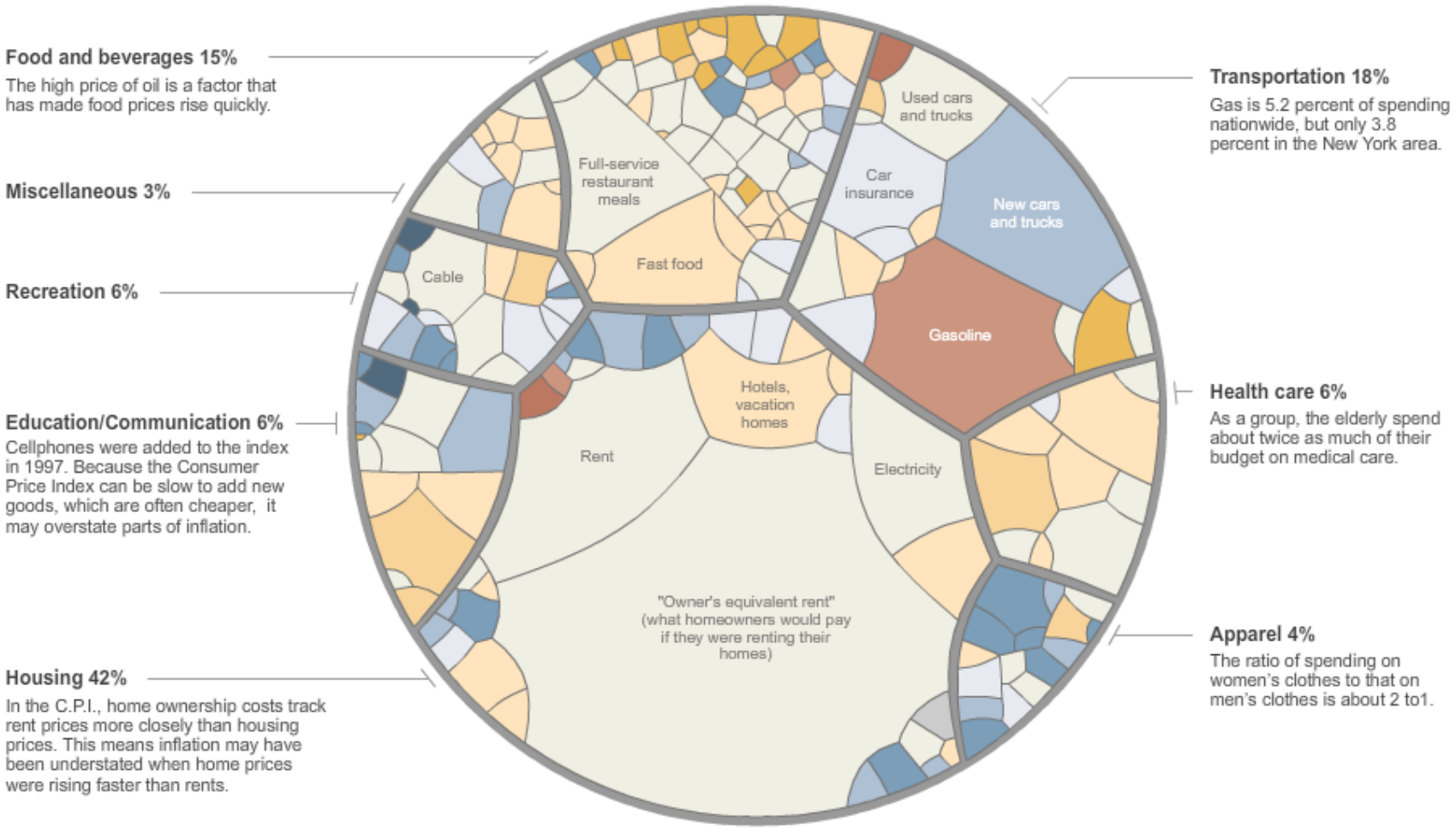
Voronoi treemap	Voronoi treemap	
	Squarified treemap	Slice-and-dice treemap



Balzer M, Deussen O. Voronoi Treemaps

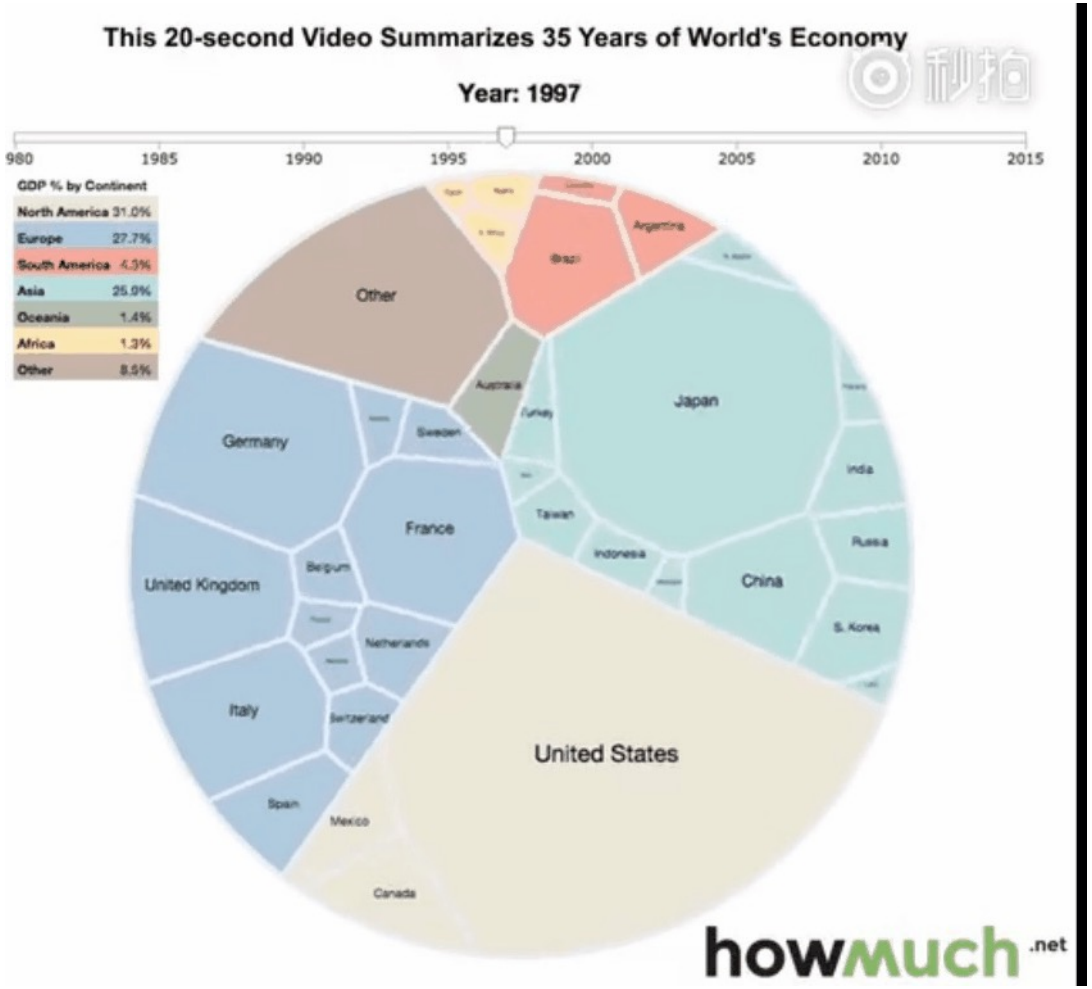
Applications of Space-Filling Methods

American Family Consumption Structure Visualization



http://nytimes.com/interactive/2008/05/03/business/20080403_SPENDING_GRAPHIC.html

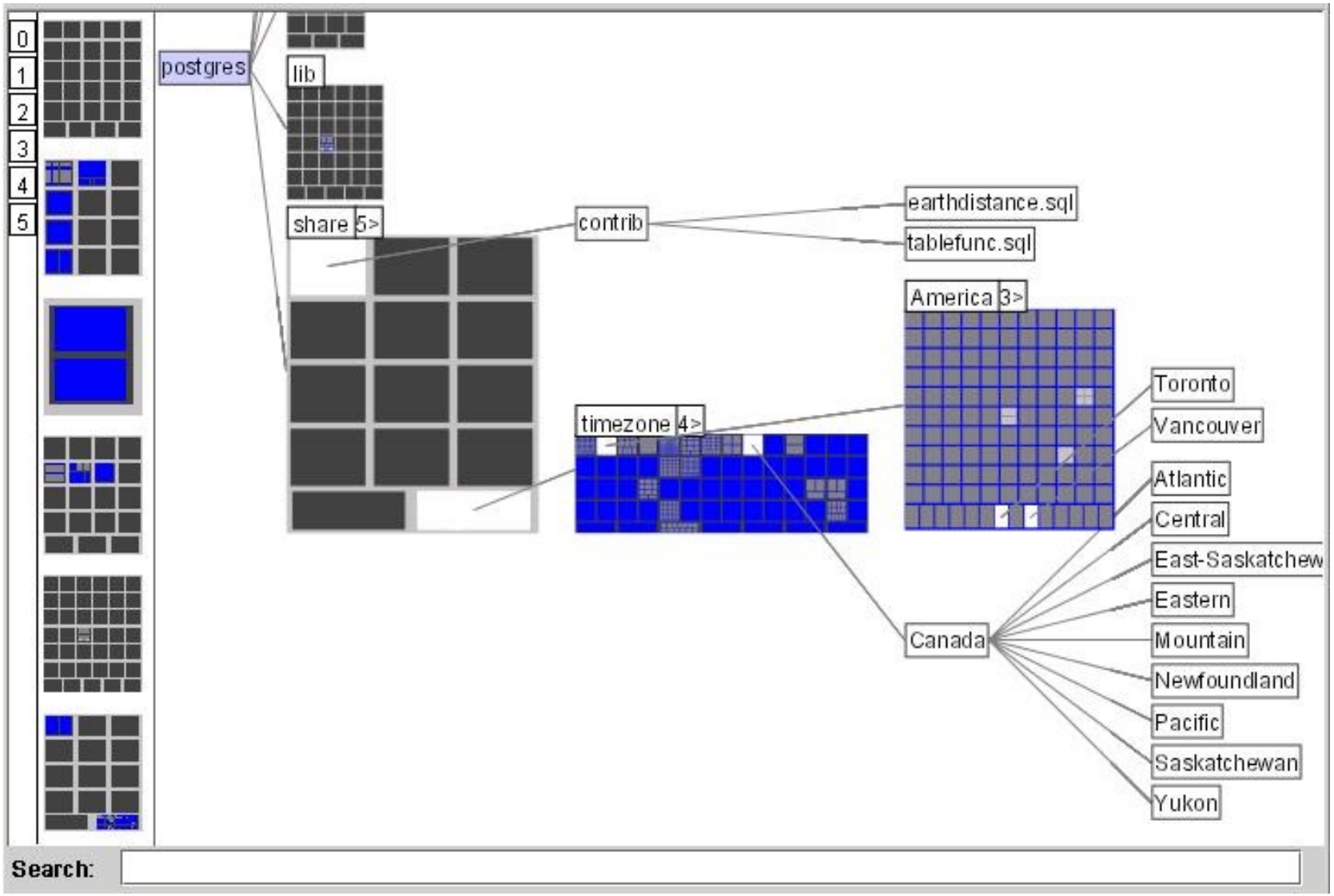
This 20-second Video Summarizes 35 Years of World's Economy



http://weibo.com/1952460384/Fa19layDU?from=page_1005051952460384_profile&wvr=6&mod=weibotime

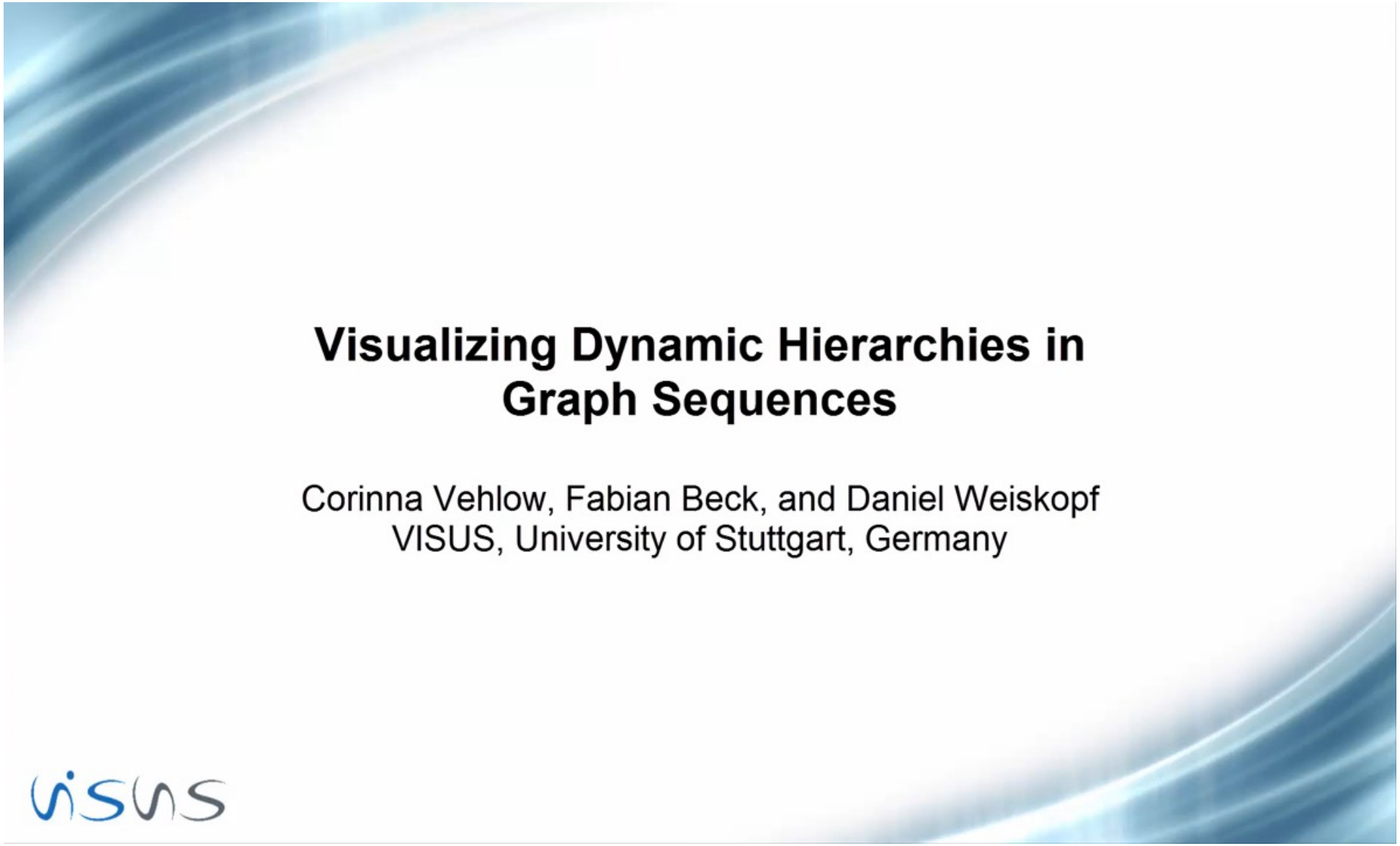

Hybrids

Elastic Hierarchies



Zhao et al. Elastic Hierarchies: Combining Treemaps and Node-link Diagrams (IEEE InfoVis 2005)

Hierarchies in Dynamic Networks



Vehlow et al. Visualizing Dynamic Hierarchies in Graph Sequences (IEEE TVCG 2015).

Aesthetical Requirements of Graph Drawing

- It applies efficiency and aesthetics principles.
  - Avoiding crossing edges.
  - Uniformly distributed nodes and edges.
  - Consistent edge length.
  - Symmetry.
- More beauty, less misleading.

Not All Requirements can be Satisfied...

There is no Silver Bullet for Visualization Either

- However a good layout algorithm can satisfy as more requirements as possible.
- Different applications better satisfy different requirements.
- It applies to all visualization work.

How Do Ancestral Traits Shape Family Trees over Generations

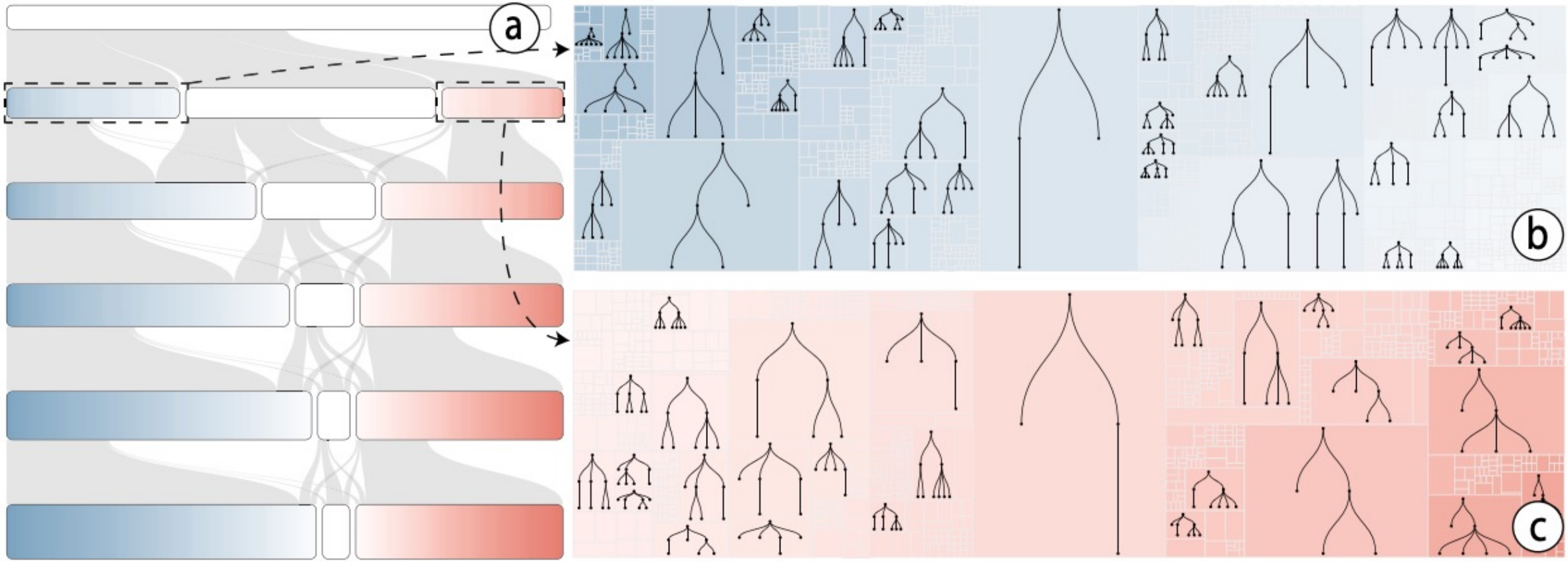
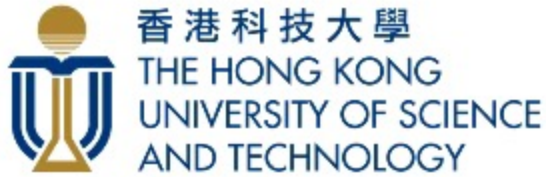


Figure 1. (a) TreeEvo organizes and demonstrates the entire collection of family trees by growth and continuity in a Sankey diagram like visualization. In this example, Sankey nodes in each row represent all trees with the same depth, which are categorized into three groups: left-inclined (blue), balanced (white), and right-inclined (red). (b) After the blue Sankey node is selected, detailed composition of the node, i.e., a set of trees, is displayed in a space-efficient layout. Trees of each specific structure are represented by a rectangle, of which the color indicates inclination and area encodes the number trees. The node-link structure of family trees is displayed if the rectangle is large enough. (c) Family trees included in the red Sankey node, which are right-inclined, are displayed upon selection.

How Do Ancestral Traits Shape Family Trees over Generations?

Siwei Fu, Hao Dong, Weiwei Cui, Jian Zhao, Huamin Qu



VIS 2019

R-Map: A Map Metaphor for Visualizing Information Reposting Process in Social Media

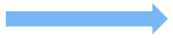
Chen S, Li S, Chen S, et al. R-map: A map metaphor for visualizing information reposting process in social media[J]. IEEE Transactions on Visualization and Computer Graphics, 2019, 26(1): 1204-1214.

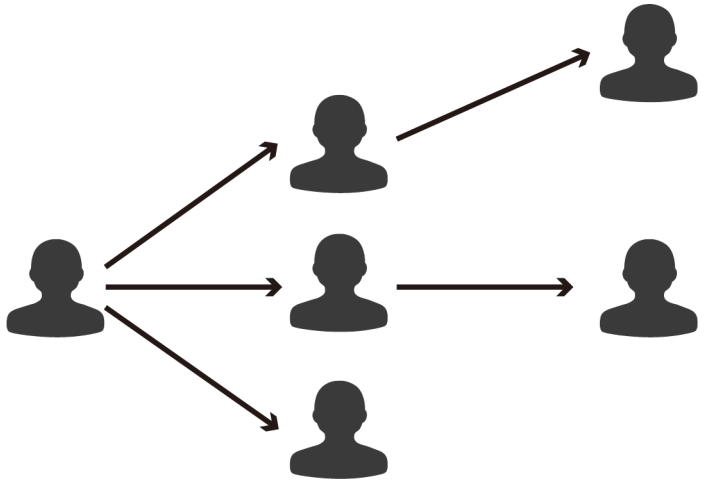
北京大学 PEKING UNIVERSITY

Fraunhofer IAIS

Information Propagation

Reposting messages

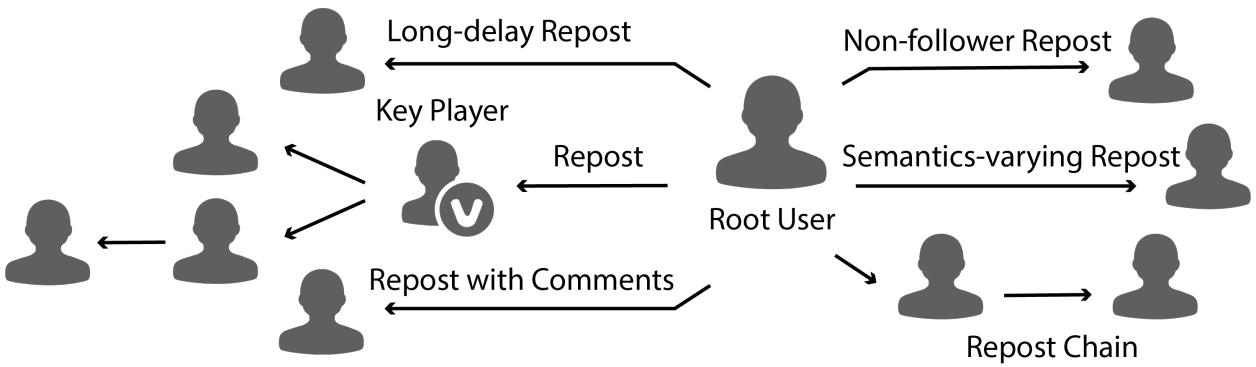




Reposting tree

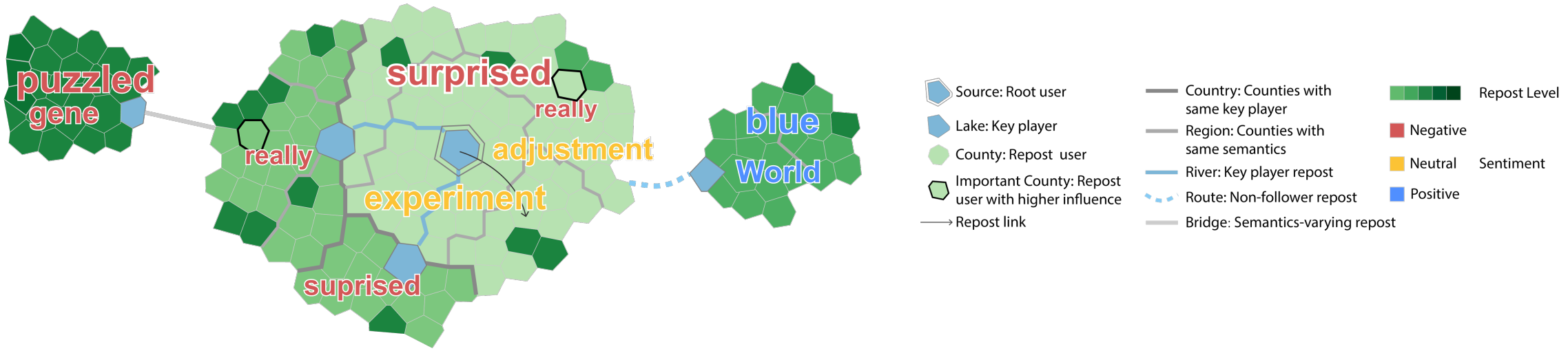
Reposting Analysis

- For one weibo with large-scale cascading repostings, the reposting process is complex
  - Hierarchical structure
  - Key player's influence
  - Dynamic diffusion process
  - Different reposting behaviors



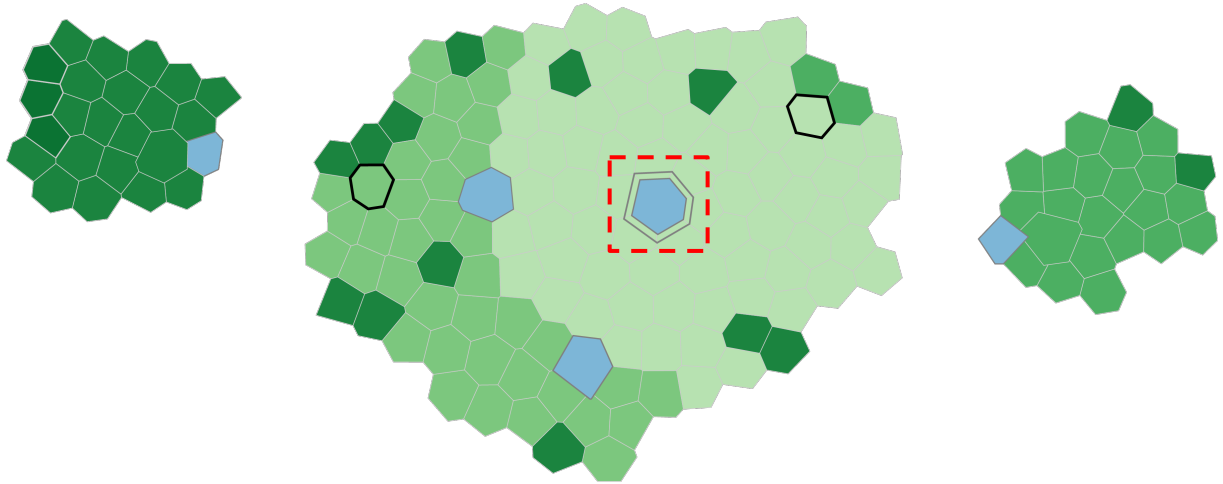
R-Map

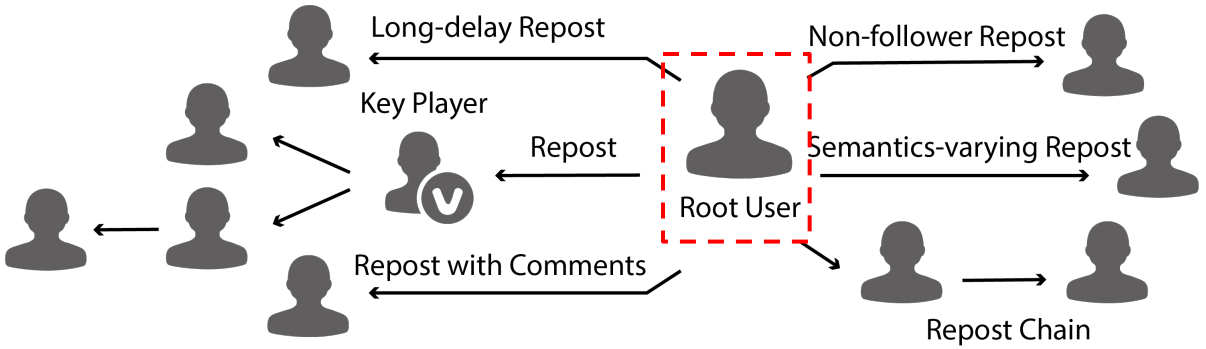
- Multifaceted information encoded with different map symbols
- Intuitive representation of a reposting tree with a compact layout



R-Map Design

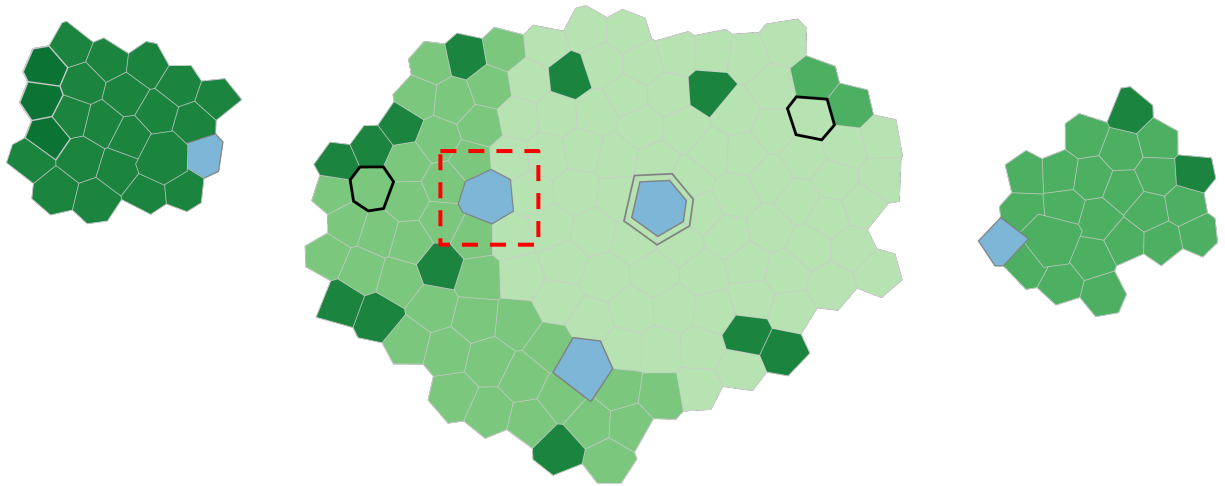
- Source: Root user
  - Creator of the original message

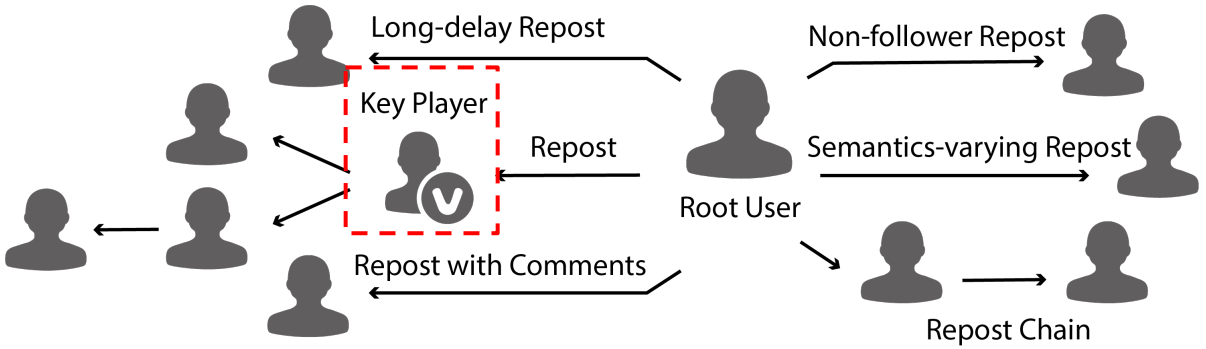




R-Map Design

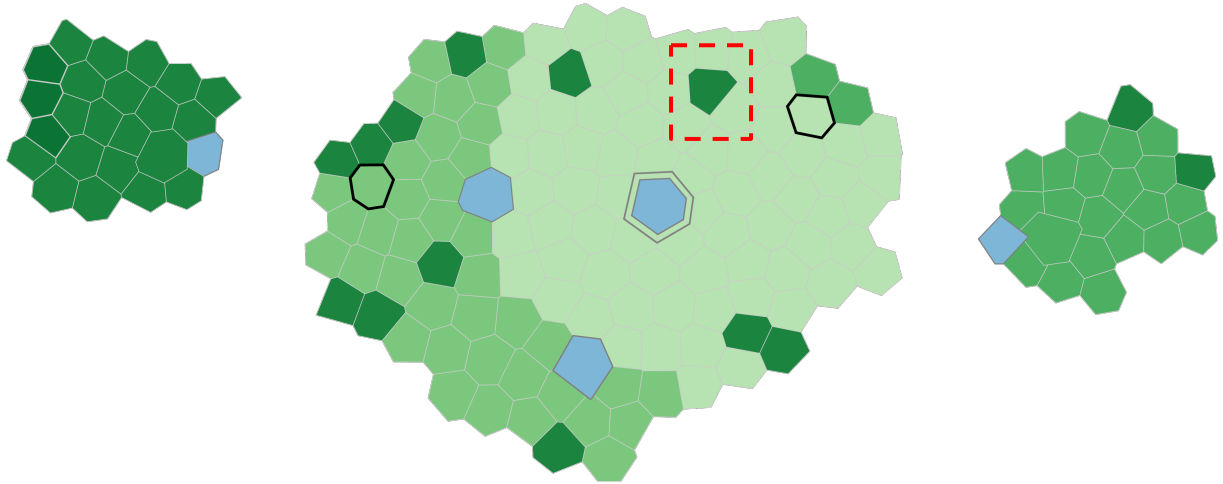
- Source: Root user
- Lake: Key player
  - Reposted by a certain number of accounts (5% of all accounts)

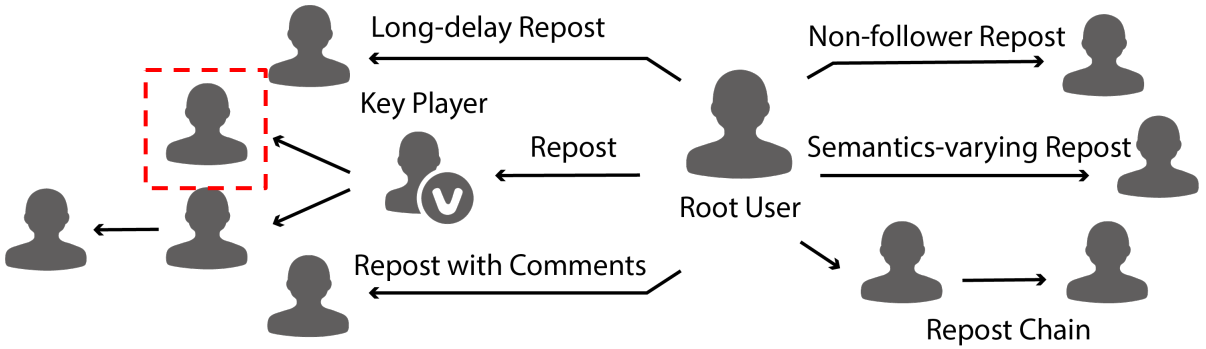




R-Map Design

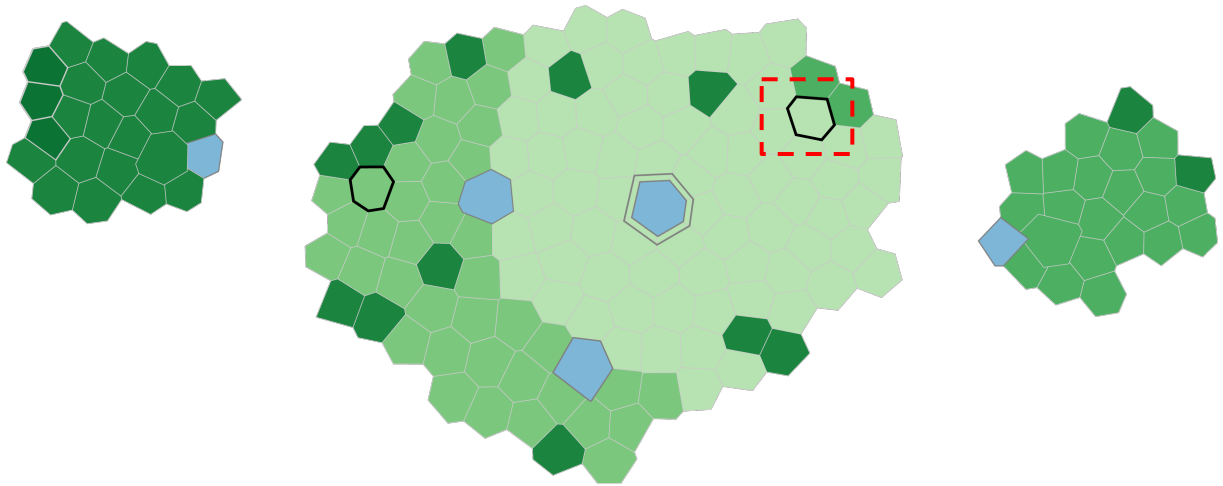
- Source: Root user
- Lake: Key player
- County: Repost user

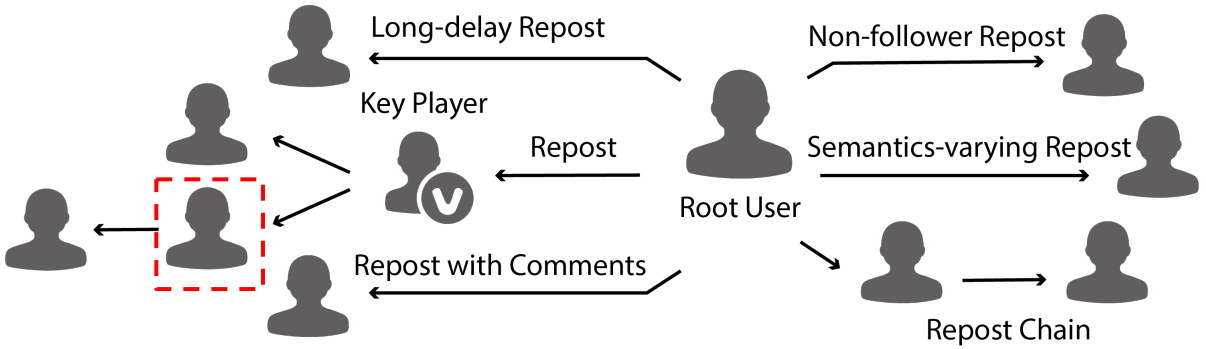




R-Map Design

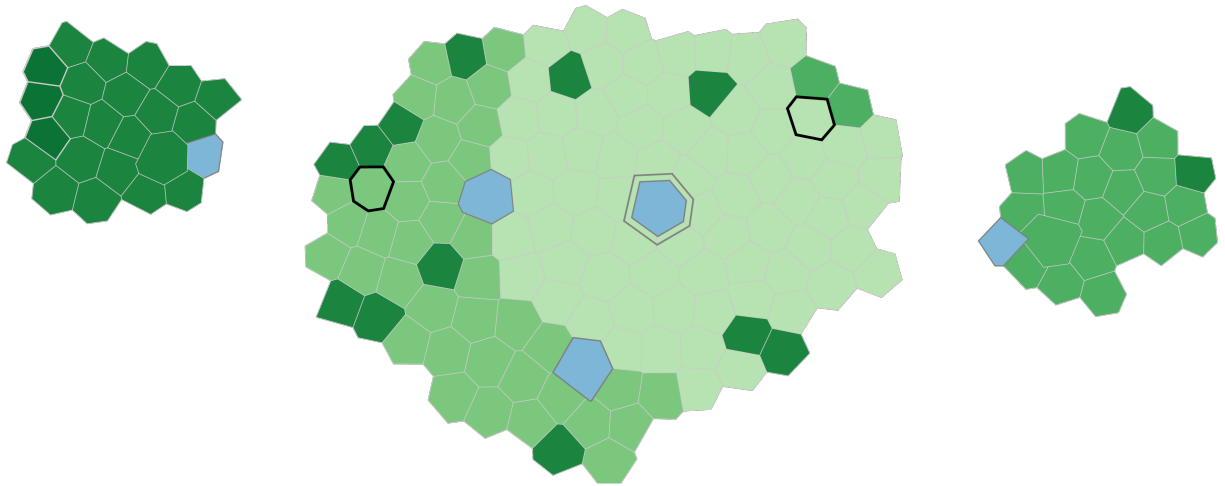
- Source: Root user
- Lake: Key player
- County: Repost user
  - Important county
    - Reposted by a certain number of accounts (1% of all accounts)

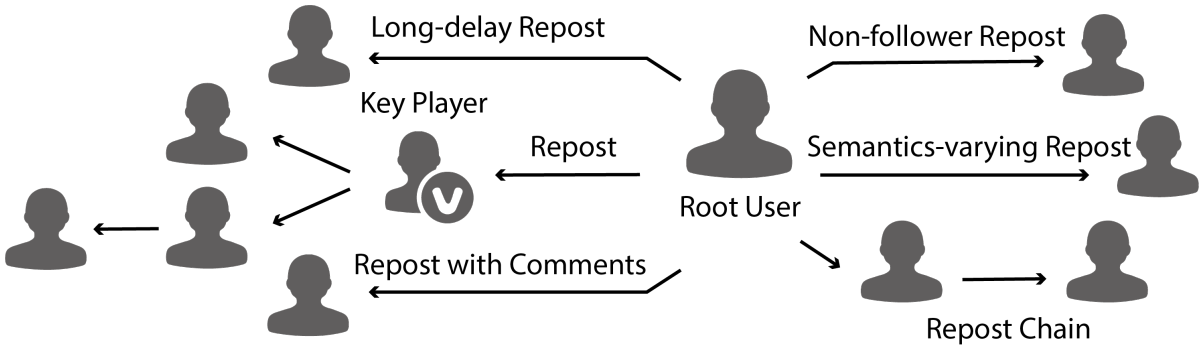




R-Map Design

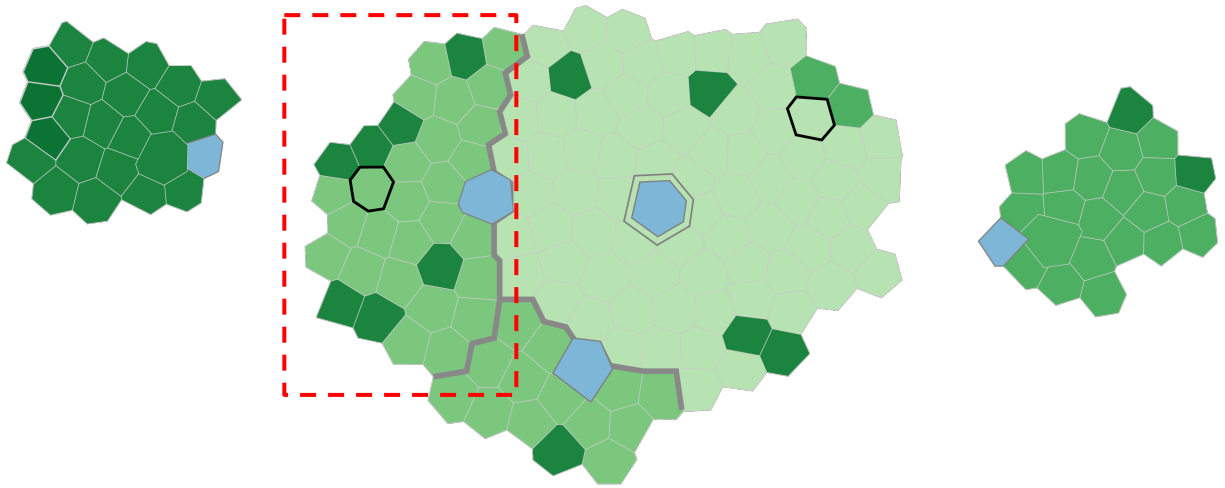
- Source: Root user
- Lake: Key player
- County: Repost user
- Color 
  - Reposting level

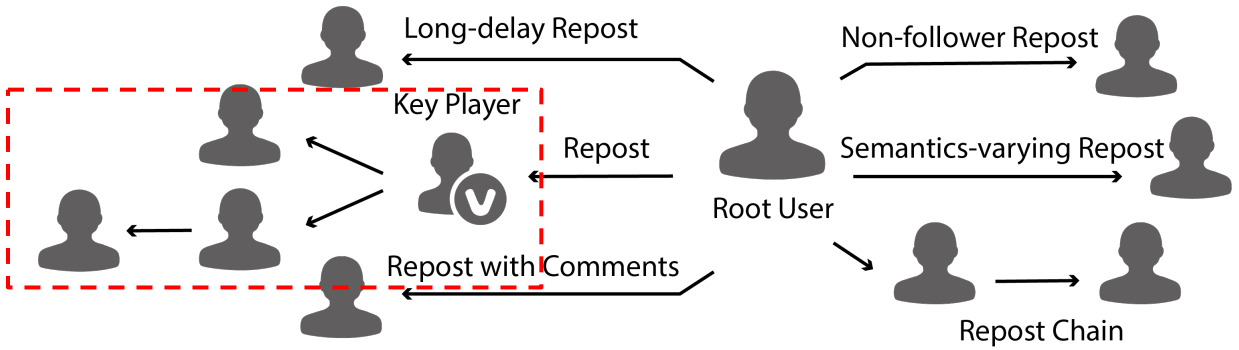




R-Map Design

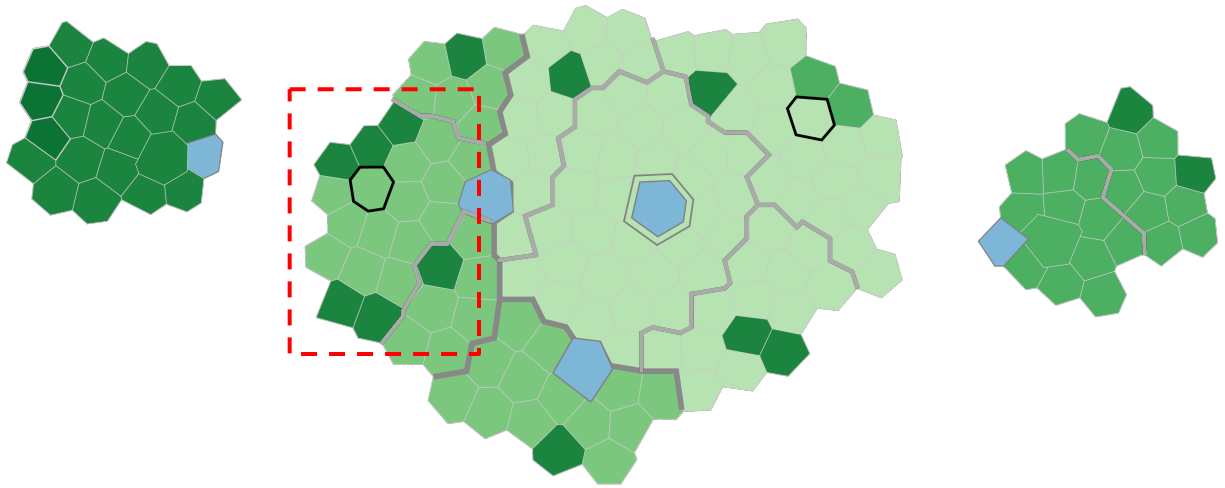
- Country
  - Counties with same key player

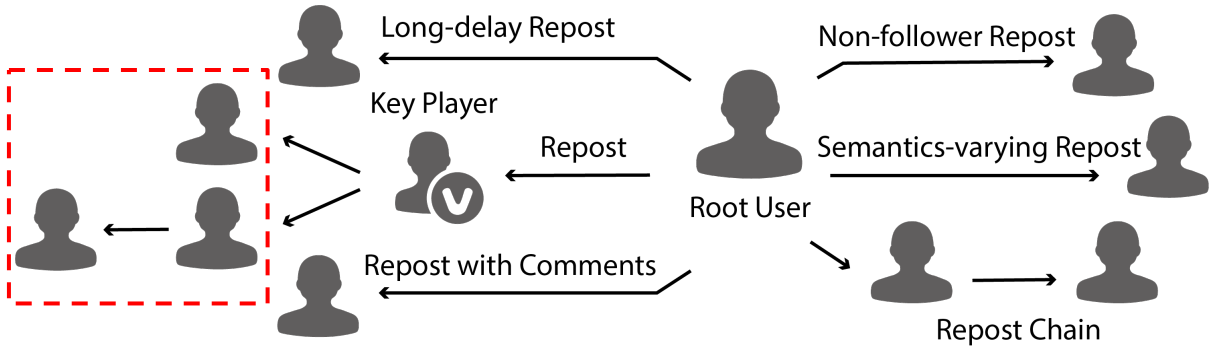




R-Map Design

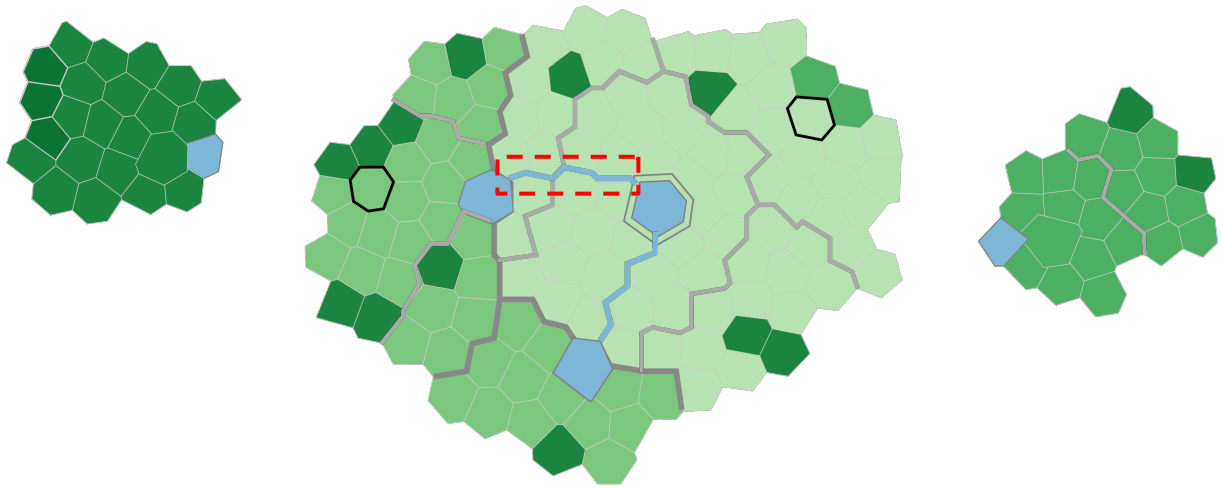
- Country
- Region
  - Counties with same semantics





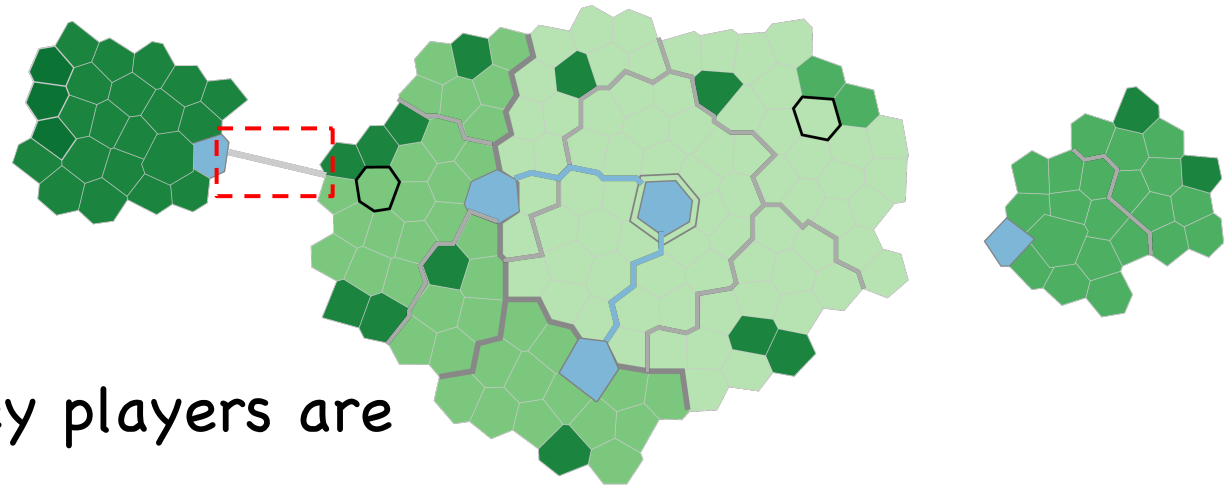
R-Map Design

- Country
- Region
- River
  - Connect key players with reposting relations



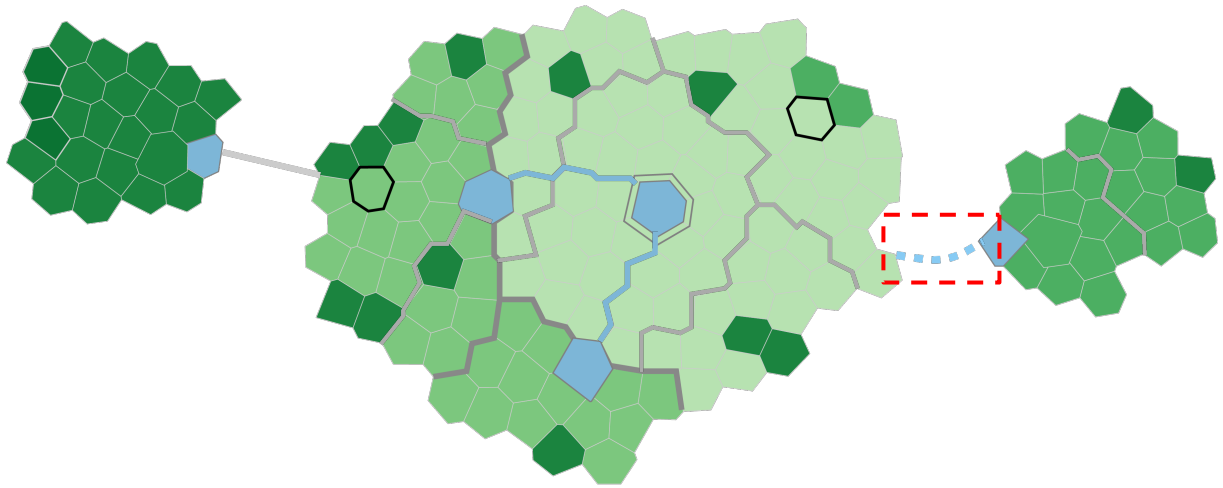
R-Map Design

- Country
- Region
- River
- Bridge
  - Messages reposting the two key players are different in semantics



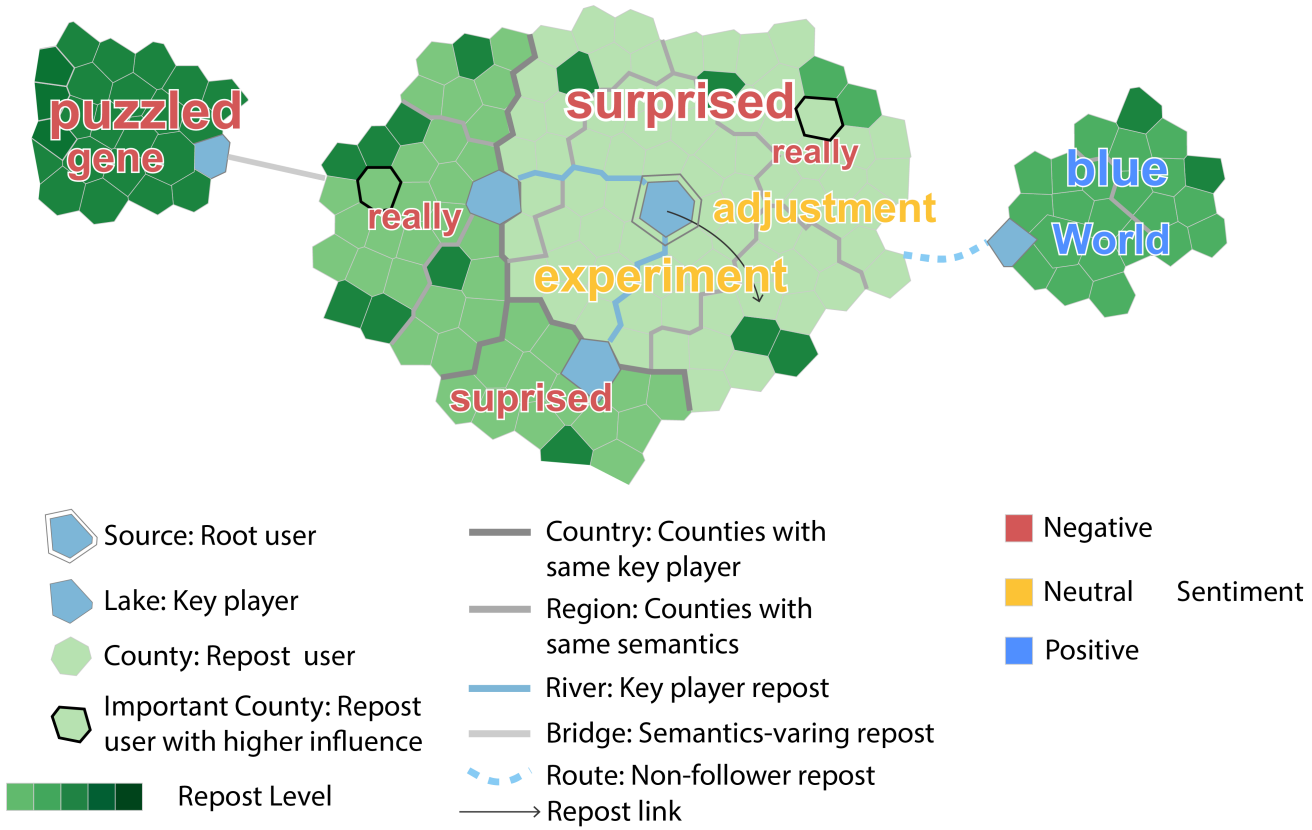
R-Map Design

- Country
- Region
- River
- Bridge
- Route
  - One key player does not follow the reposted key player



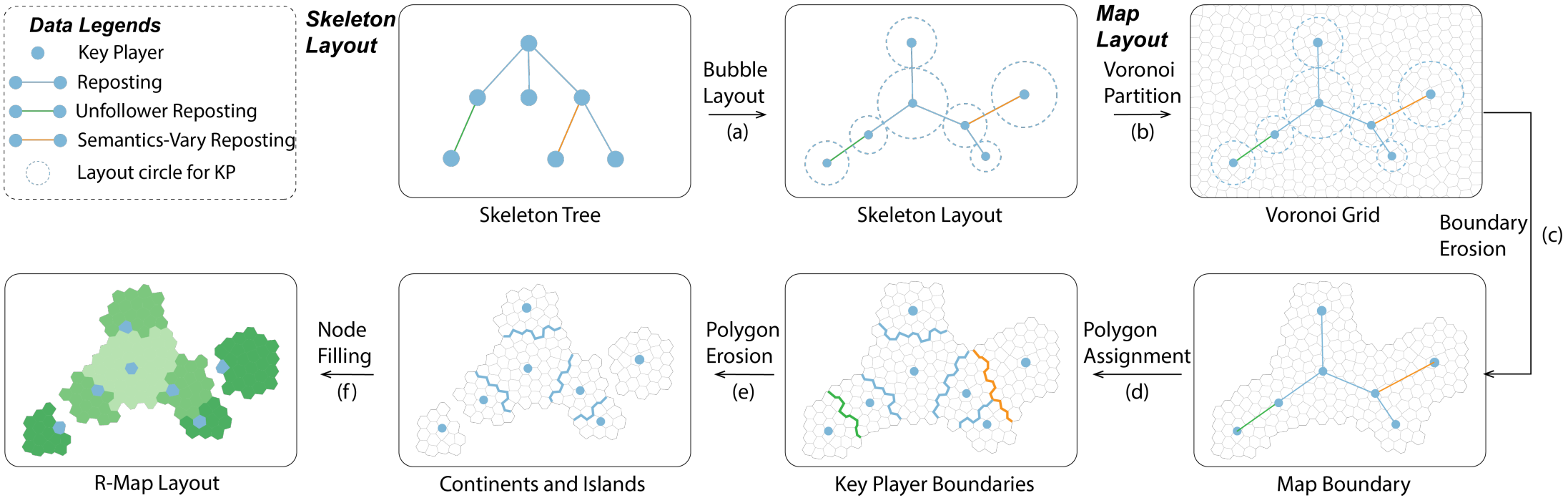
R-Map Design

- Keywords
  - Topics discussed in different regions or countries
  - Color
    - Red: negative
    - Yellow: neutral
    - Blue: positive



R-Map Construction Process

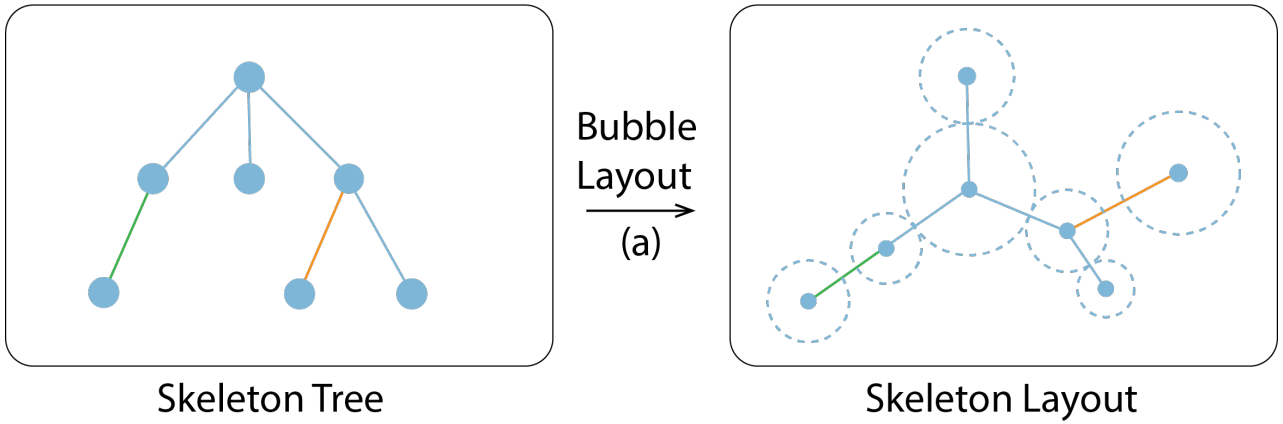
- Extract key players
- Construct skeleton and fill in nodes

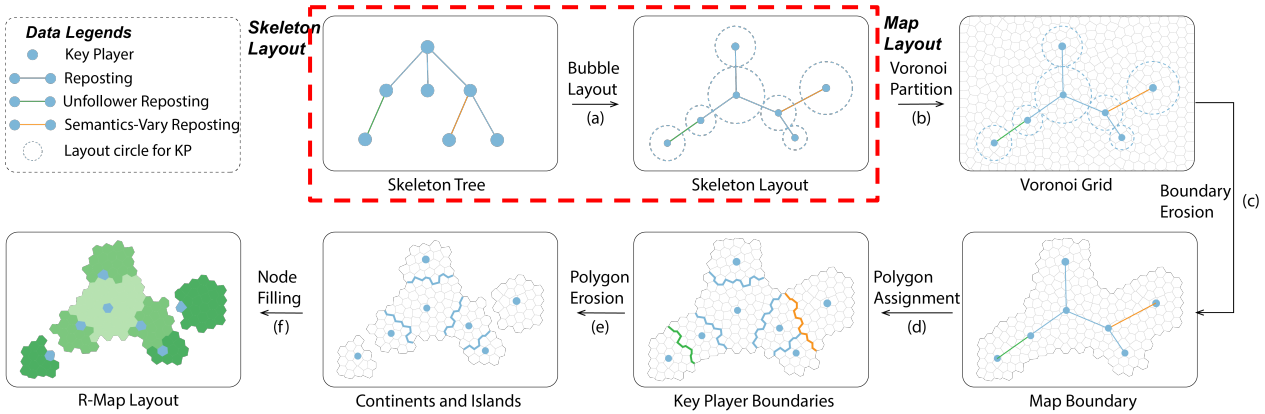


Layout Pipeline

R-Map Construction – Bubble Layout

- Input
  - Skeleton tree of key players
- Process
  - Run a bubble tree layout
    - $r = \sqrt{(K.descendants.length)}$
  - Add extra space between non-follower repostings and semantics-vary repostings
- Output
  - Layout of key players

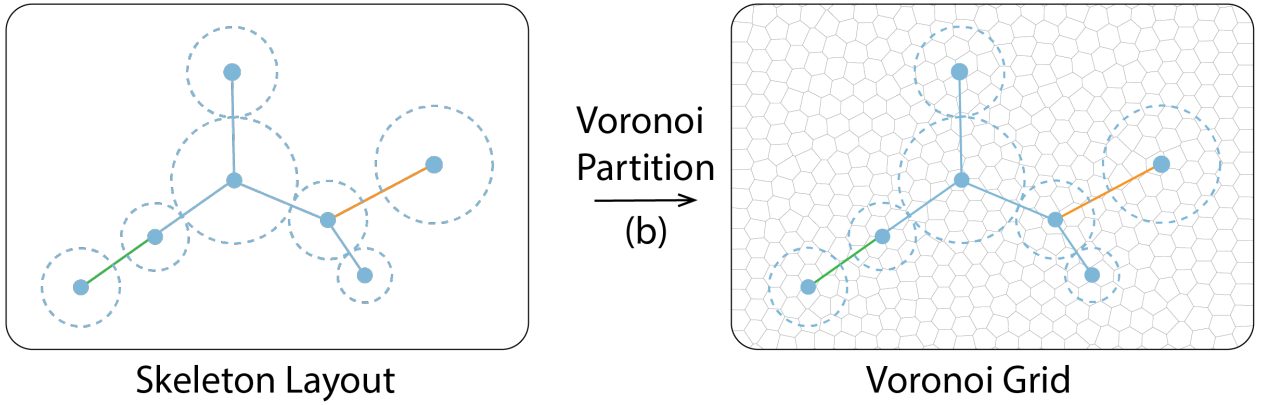


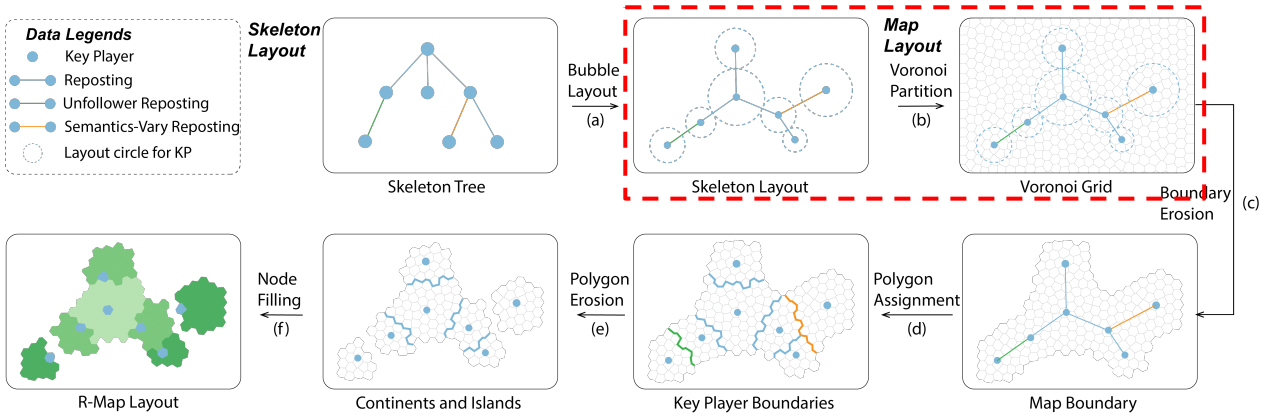


Sébastien Grivet, David Auber, Jean-Philippe Domenger, Guy Melançon. Bubble Tree Drawing Algorithm. ICCVG 2004: 633-641.

R-Map Construction – Voronoi Partition

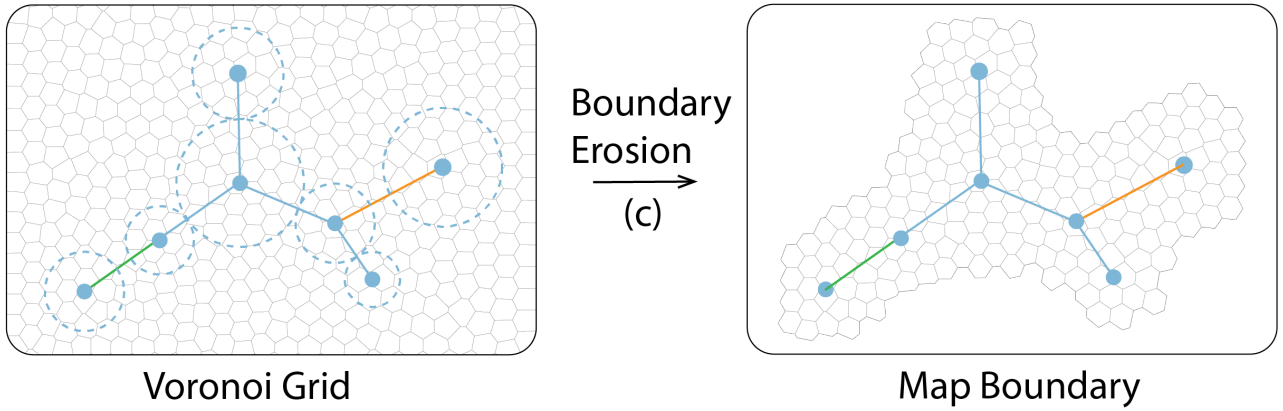
- Input
  - Key players layout
- Process
  - Calculate the bounding box
  - Divide the plane by a Voronoi diagram
- Output
  - A Voronoi diagram

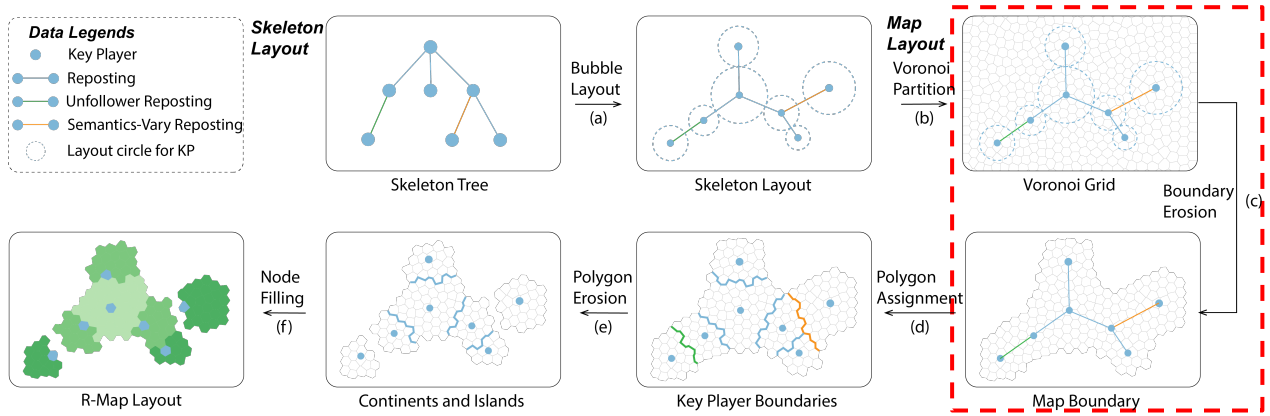




R-Map Construction – Boundary Erosion

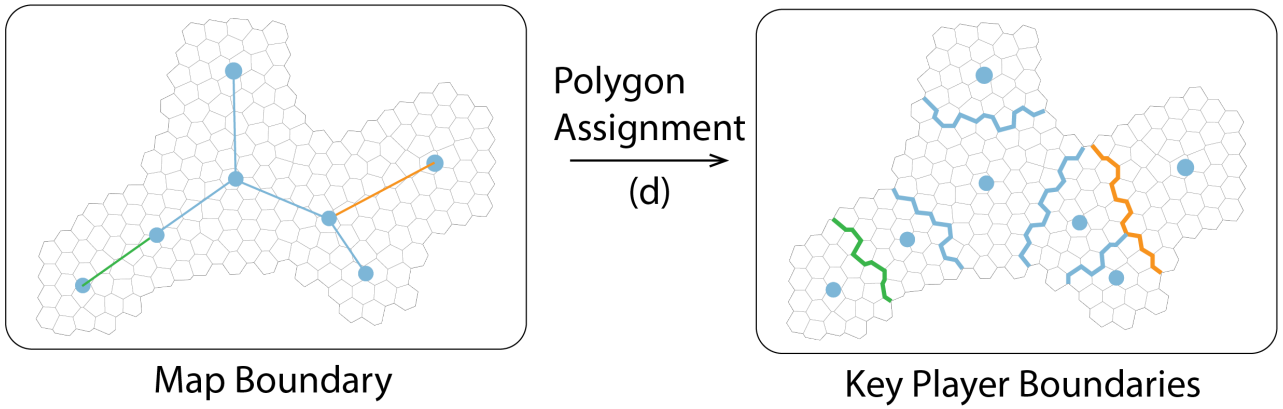
- Input
  - Key player layout
  - Voronoi diagram
- Process
  - Make a splatting of the key player node using a Gaussian Kernel
  - Filter out polygons with density value below the threshold
- Output
  - Initial map shape

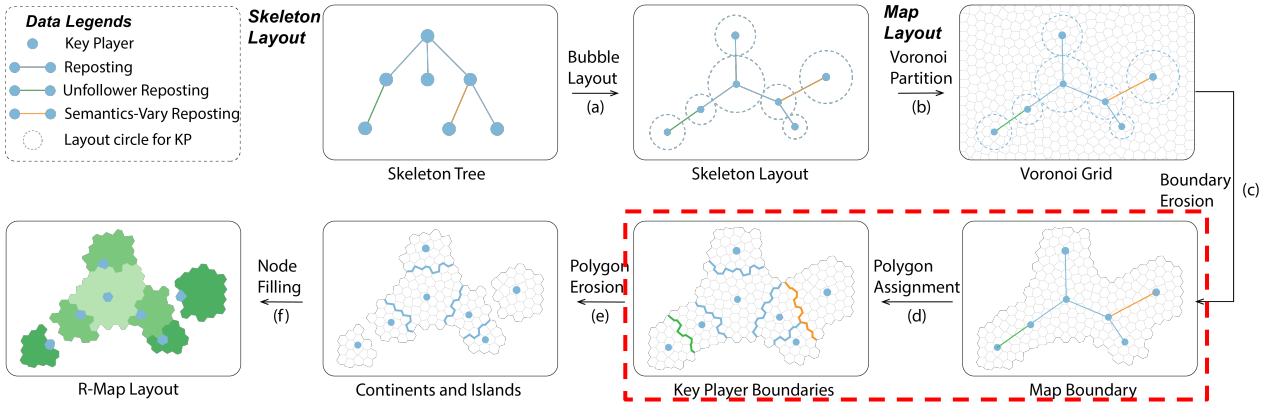




R-Map Construction – Polygon Assignment

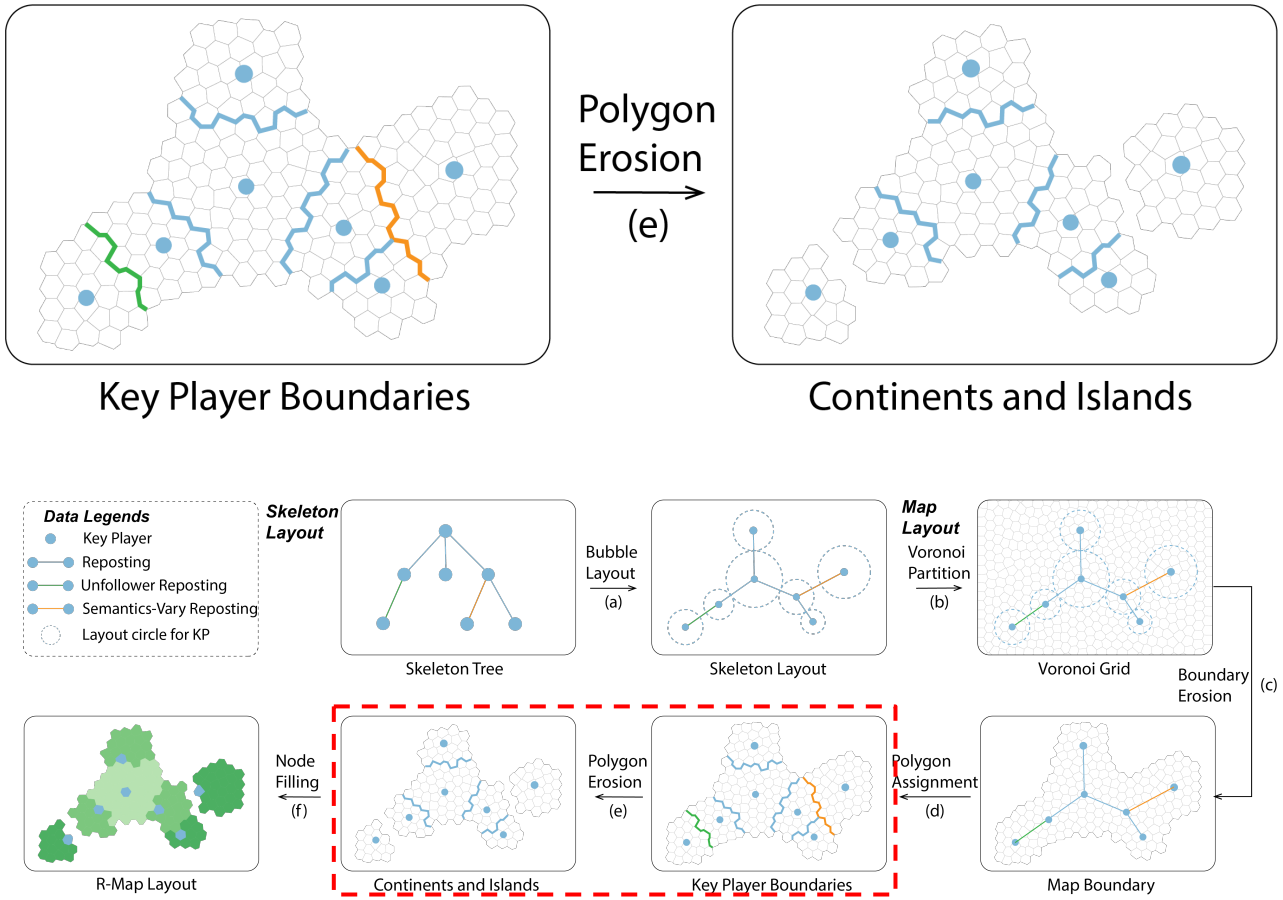
- Input
  - Key players layout
  - Initial map polygons
- Process
  - Assign polygons to key players according to Euclidean distance
- Output
  - Allocated polygons





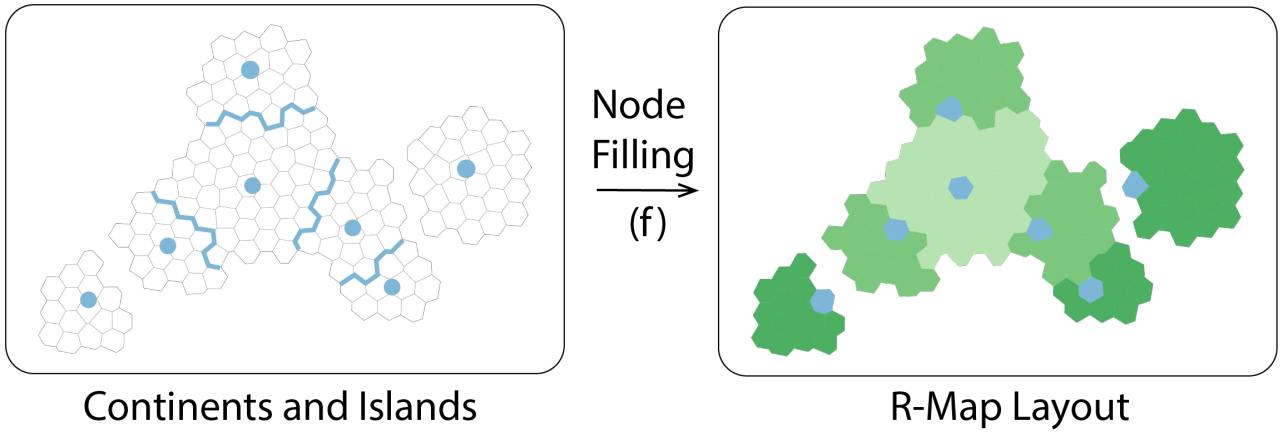
R-Map Construction – Polygon Erosion

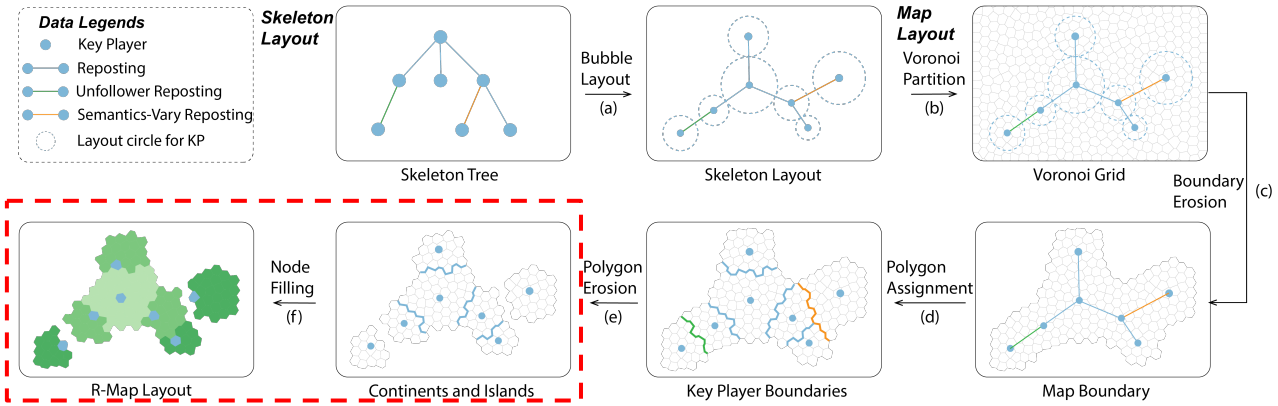
- Input
  - Key players layout
  - Allocated polygons
- Process
  - Adjust polygons
    - Make the number of polygons equal to the descendants
    - Split out islands
- Output
  - Final map shape



R-Map Construction – Node Filling

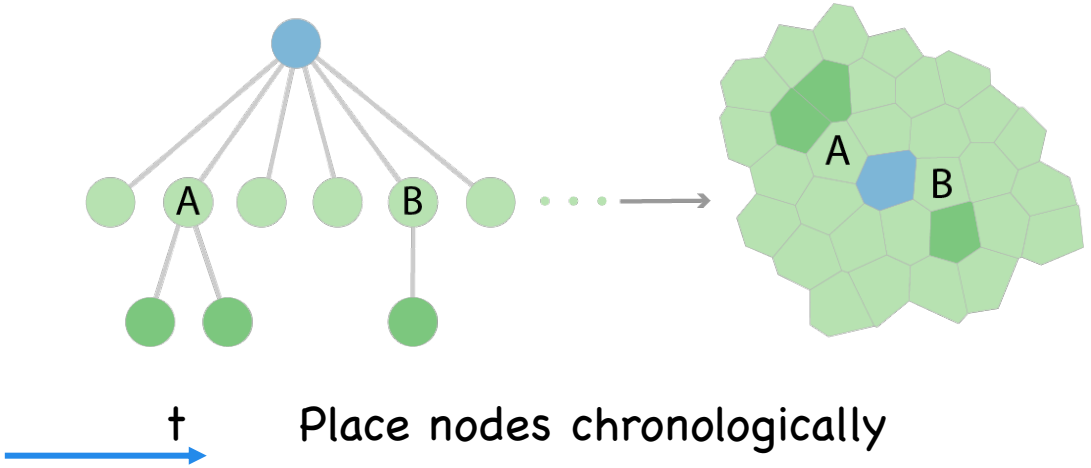
- Input
  - Key players
  - Map polygons
- Process
  - Assign allocated polygons of key players to its descendant nodes
- Output
  - R-Map Layout

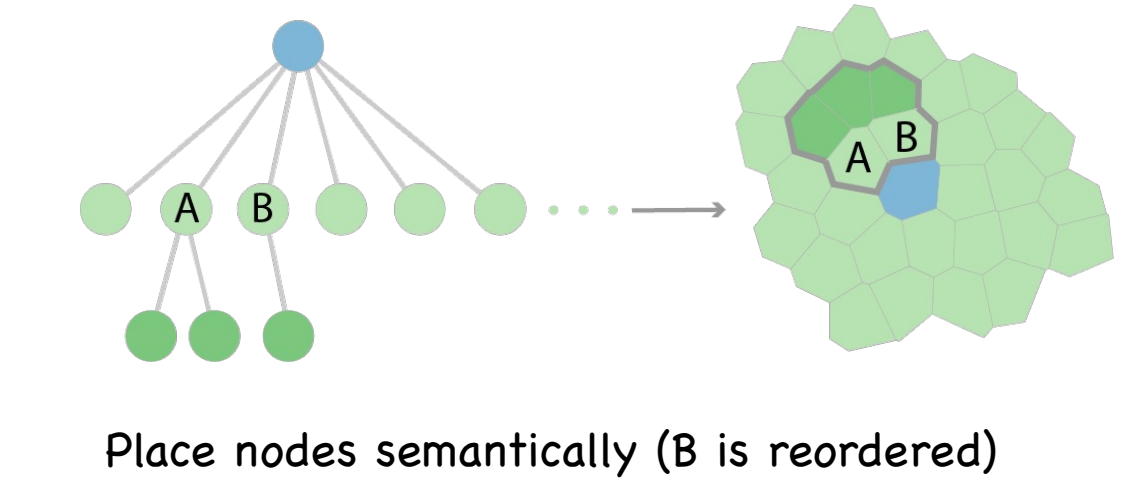




Filling Methods

- Time
  - Place nodes chronologically from inside to outside with a depth-first strategy
  - Keep nodes of a subtrees within a continuous area
- Semantics
  - Group siblings with similar semantics first
  - Place nodes chronologically from inside to outside with a depth-first strategy
  - Generate regions on the map





(a) Source Weibo List

Search:

Name	Weibo	Time	N	D
南小七7	@姚晨 你好，我	2012-03-03	249	1
CH_冻了个柠	帮转@姚晨	2012-03-03	0	2
Dispatch林烺	欣赏你。 顶一下	2012-03-03	1	2
林小洞洞	加油！！！@姚	2012-03-03	0	2
REMOLD_轰	帮转！！求扩散	2012-03-03	3	2
CH_冻了个柠	@木字在边_边边	2012-03-03	0	3
REMOLD_轰	扩散～@小-倩q	2012-03-03	0	3
爱吃水果的小	喜欢你甜甜的笑	2012-03-03	0	3
没什么不要关	转发微博	2012-03-03	0	3
南小七7	真心很感谢今天	2012-03-03	5	2

Showing 1 to 10 of 2,865 entries

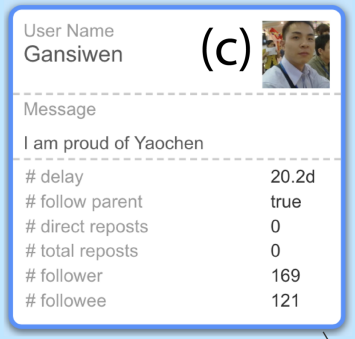
Previous 1 2 3 4 5 ... 287 Next

(e) Word Cloud

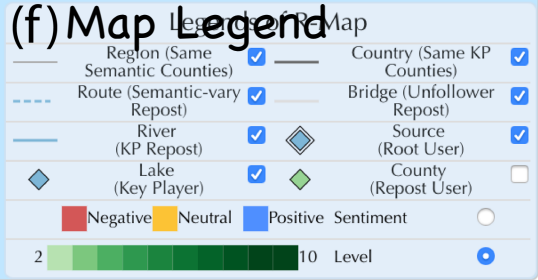
(b) Map View

Keyword Name Single Multiples Time Semantics En Legend

(c) User Information Panel

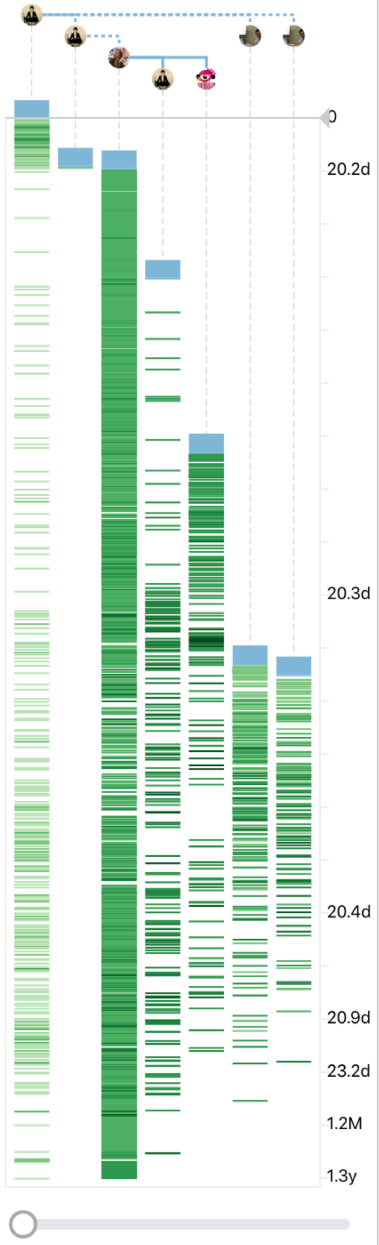


(f) Map Legend



(d) Timeline

Play Reset

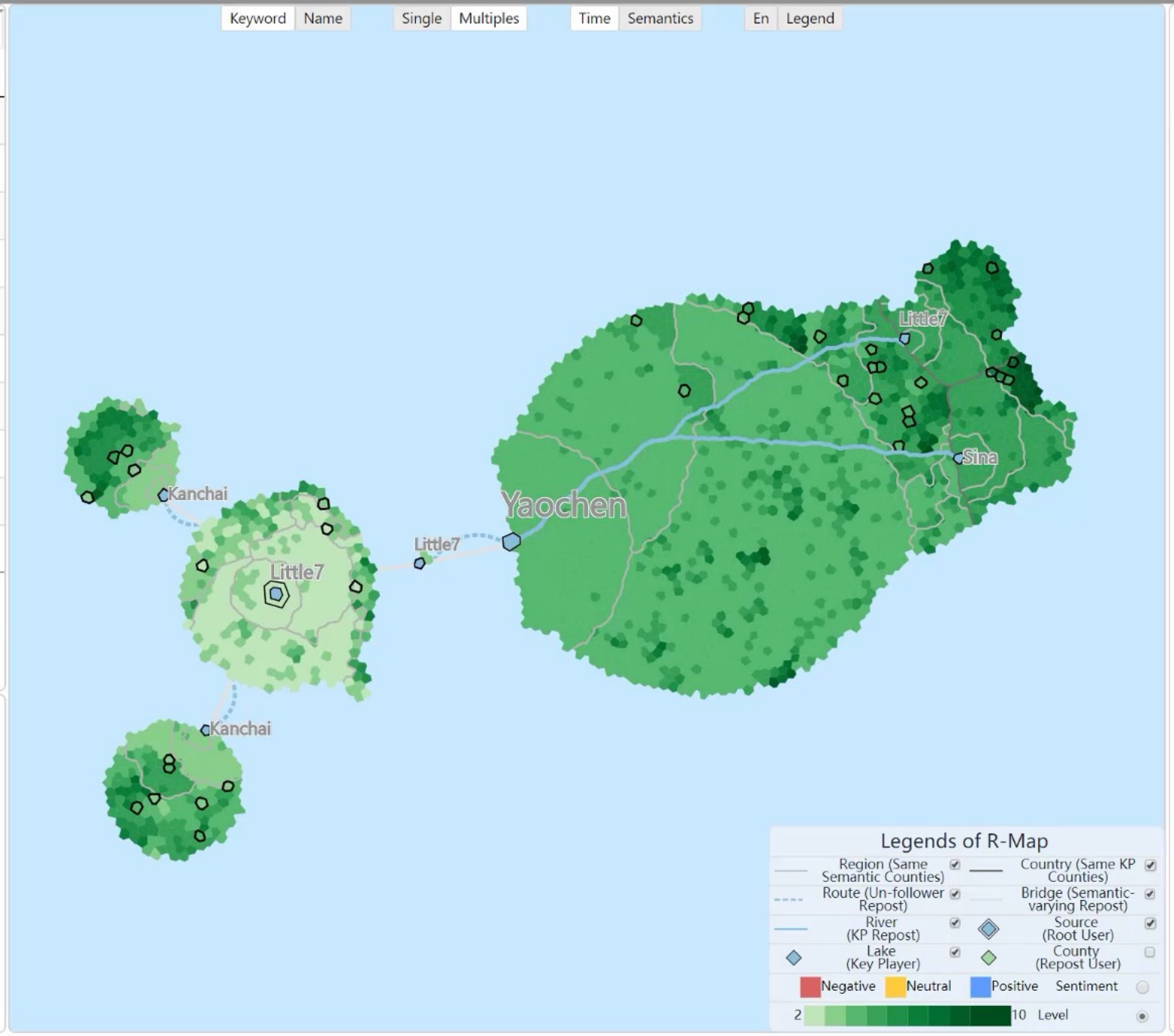


Show 10 entries Search:

Name	Weibo	Time	N	D
南小七7	@姚晨 你好，我	2012-03-03 1	249	1
CH_冻了个柠柠	帮转@姚晨	2012-03-03 1	0	2
Dispatch林娘	欣赏你。 顶一下	2012-03-03 1	1	2
林小洞洞	加油！！！@姚晨	2012-03-03 1	0	2
REMOLD_轰	帮转！！求扩散！	2012-03-03 1	3	2
CH_冻了个柠柠	@木字在边_边边	2012-03-03 1	0	3
REMOLD_轰	扩散～@小-倩qia	2012-03-03 1	0	3
爱吃水果的小毛	喜欢你甜甜的笑容	2012-03-03 1	0	3
没什么不要关注	转发微博	2012-03-03 1	0	3
南小七7	真心很感谢今天帮	2012-03-03 2	5	2

Showing 1 to 10 of 2,865 entries

Previous 1 2 3 4 5 ... 287 Next



Case 1: Key Players' Influence

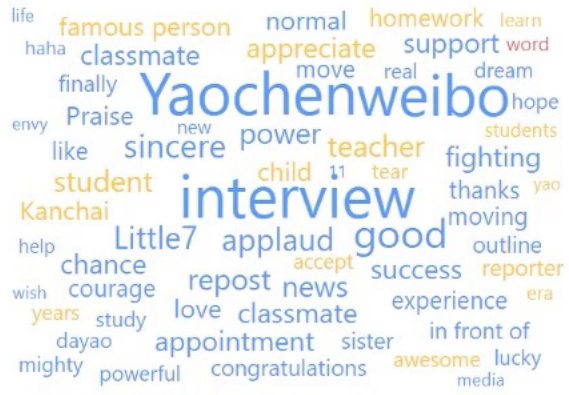
- Data
  - An account ID "Little7" invited a famous account ID "Yaochen" for an interview on Sina Weibo
  - 2864 reposting weibos in total

Show 10 entries Search:

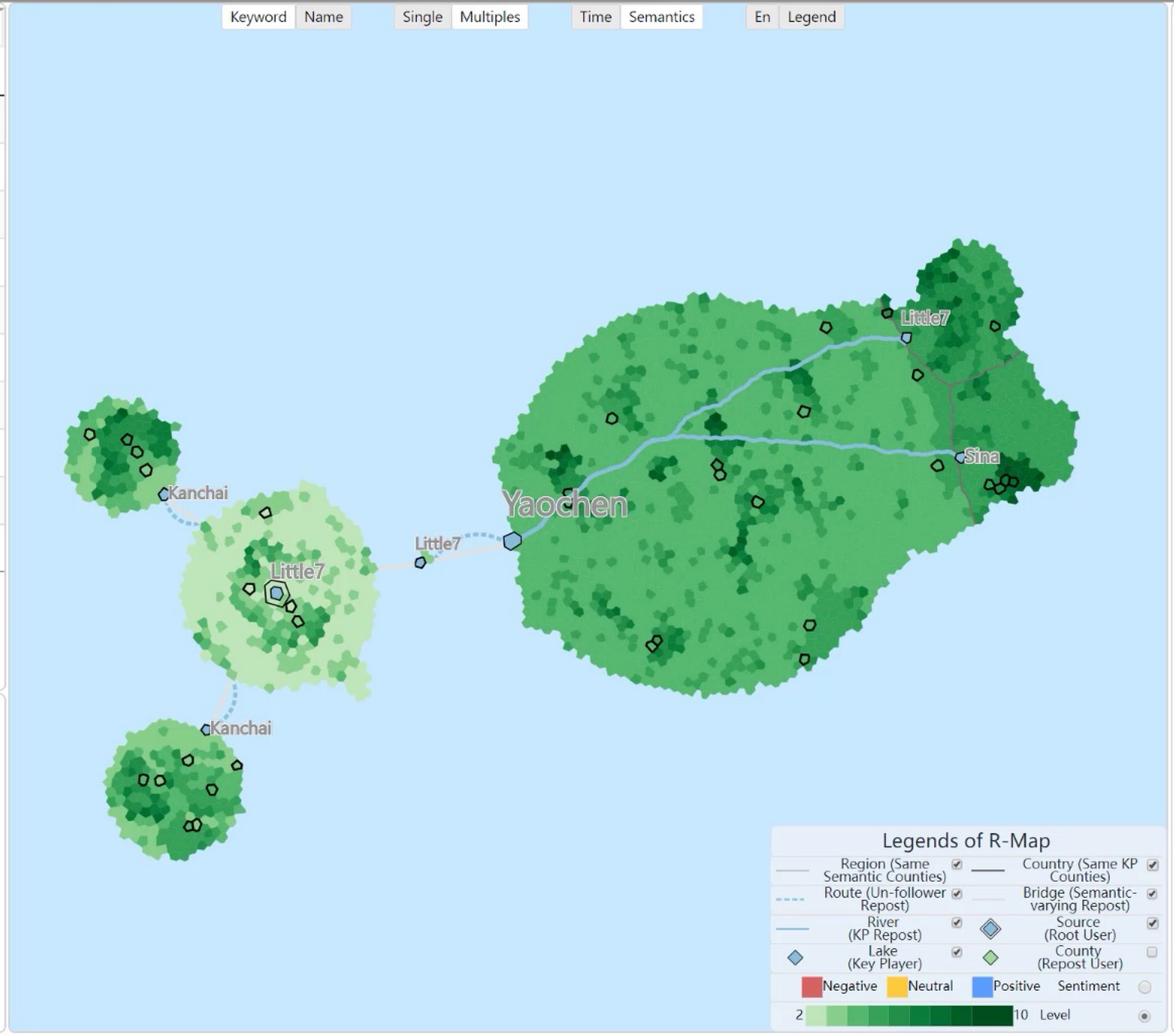
Name	Weibo	Time	N	D
南小七7	@姚晨 你好，我	2012-03-03	249	1
CH_冻了个柠柠	帮转@姚晨	2012-03-03	0	2
Dispatch林煨	欣赏你。 顶一下	2012-03-03	1	2
林小洞洞	加油！！！@姚	2012-03-03	0	2
REMOLD_轰	帮转！！求扩散	2012-03-03	3	2
CH_冻了个柠柠	@木字在边_边边	2012-03-03	0	3
REMOLD_轰	扩散～@小-倩qi	2012-03-03	0	3
爱吃水果的小毛	喜欢你甜甜的笑	2012-03-03	0	3
没什么不要关注	转发微博	2012-03-03	0	3
南小七7	真心很感谢今天	2012-03-03	5	2

Showing 1 to 10 of 2,865 entries

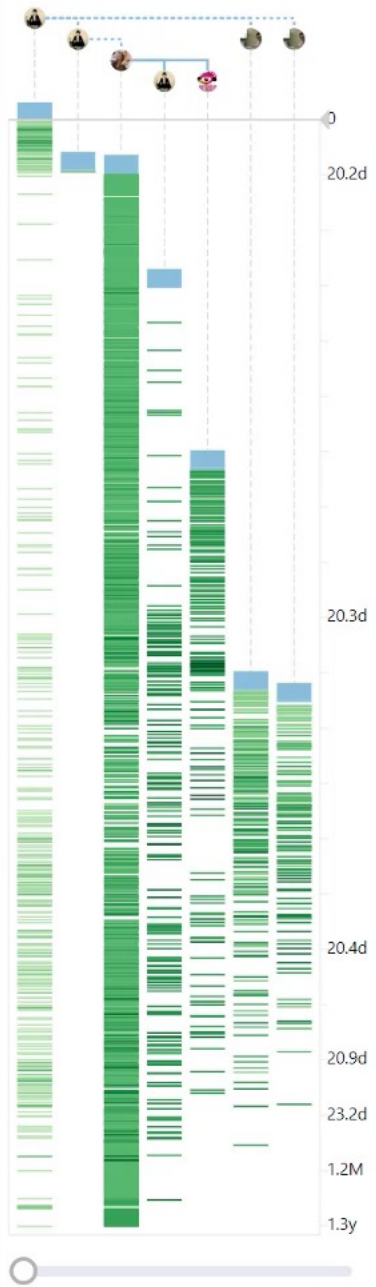
Previous 1 2 3 4 5 ... 287 Next



Keyword Name Single Multiples Time Semantics En Legend



Play Reset



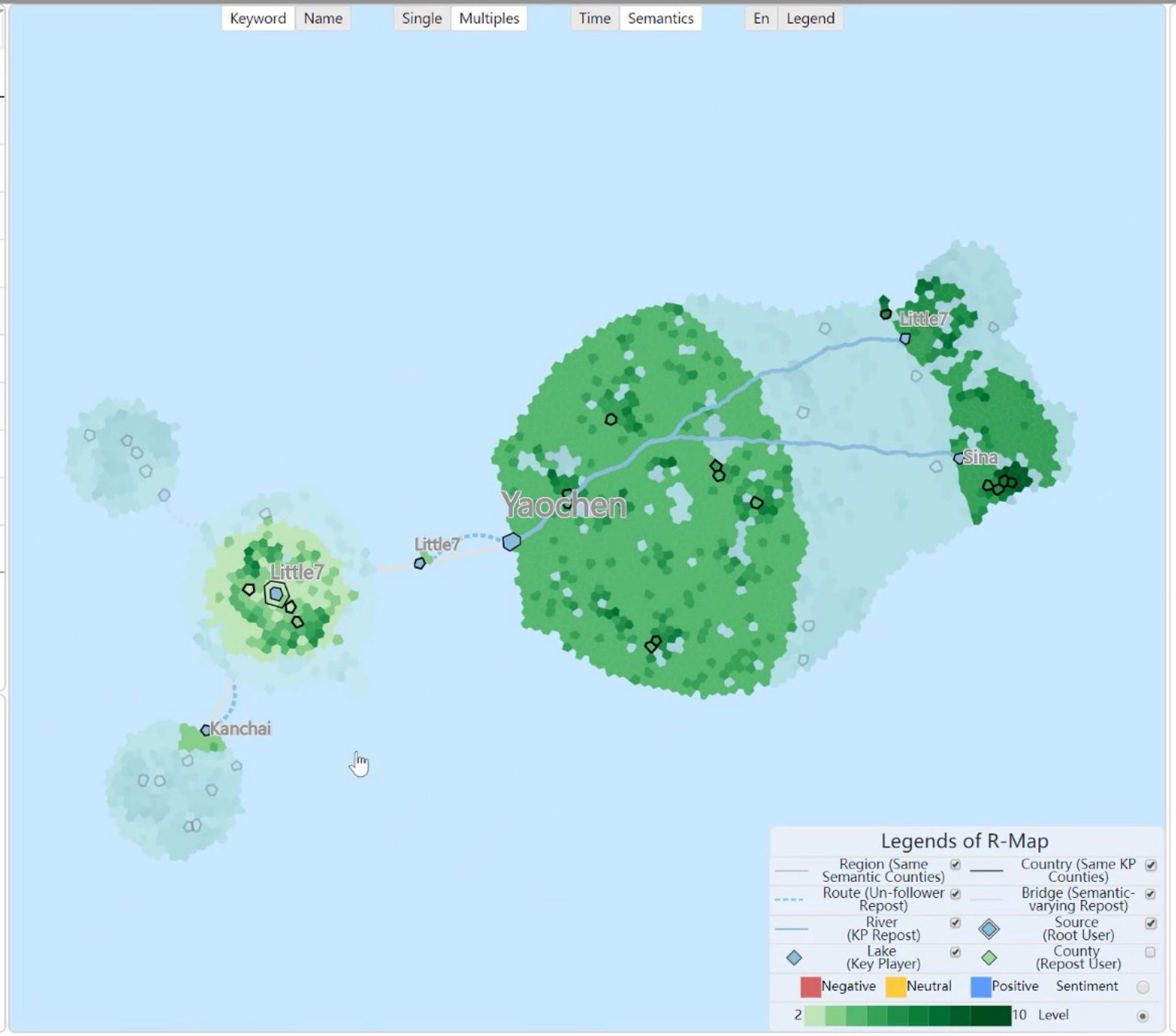
Show 10 entries Search:

Name	Weibo	Time	N	D
九歌兮山鬼	的确，俺也觉得这	2012-03-23 2	0	3
IT菜农	砍柴十年，您砍过	2012-03-23 2	0	3
马克杯	转发微博	2012-03-23 2	0	3
卡布奇诺Q_Q	转发微博	2012-03-23 2	0	4
下马微	装什么装 奴才[笑	2012-03-23 2	0	3
羊晚招财猫	转发微博	2012-03-23 2	0	4
圣谛公号	越来越傻逼！	2012-03-23 2	0	3
苏永通	你用得没错啊！问	2012-03-23 2	3	3
夜问·yewen365	看看。看看。	2012-03-23 2	2	5
Summer_捏O_o	哇。幸运的师妹！	2012-03-23 2	1	6

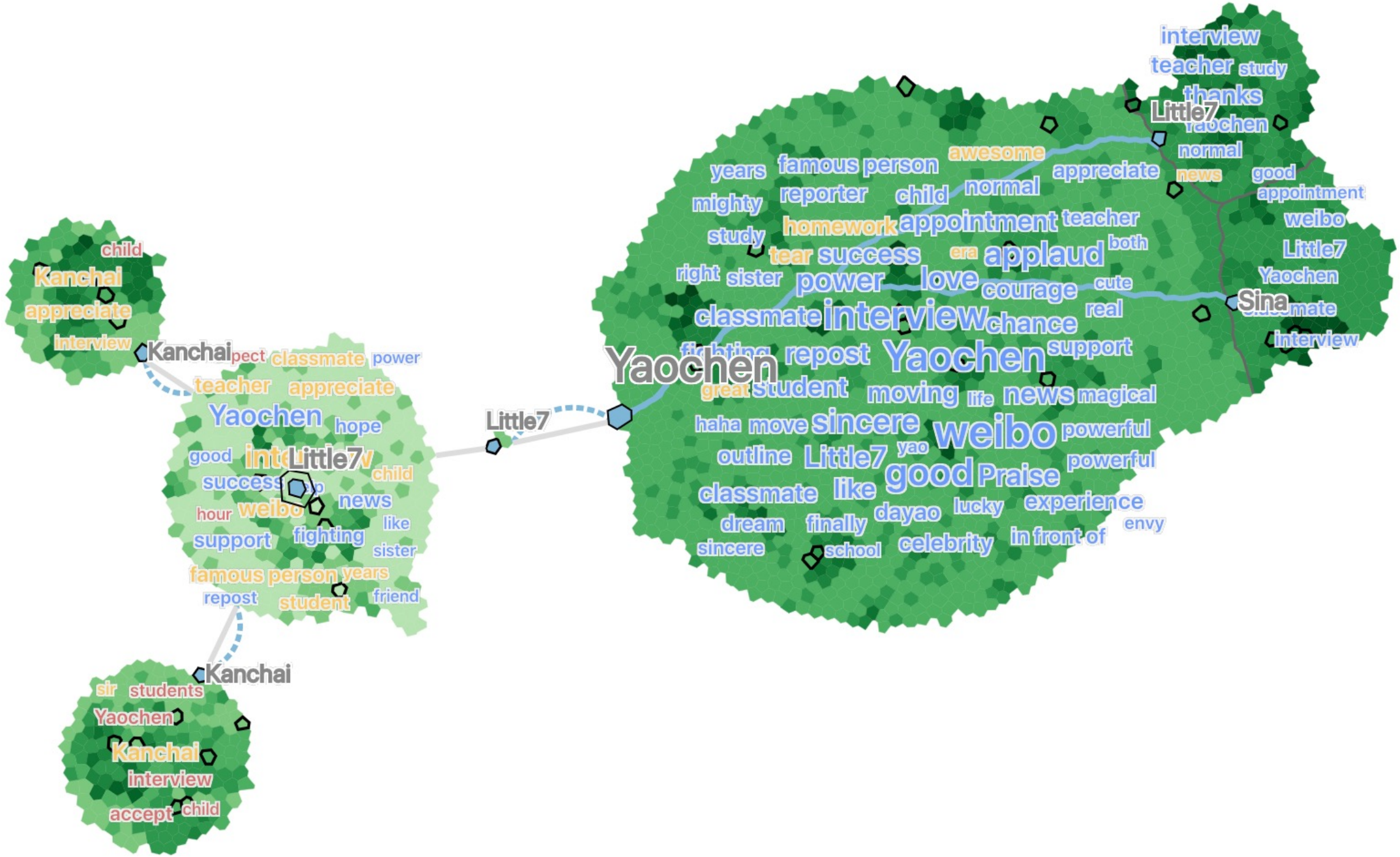
Showing 1 to 10 of 87 entries

Previous 1 2 3 4 5 ... 9 Next

Keyword Name Single Multiples Time Semantics En Legend



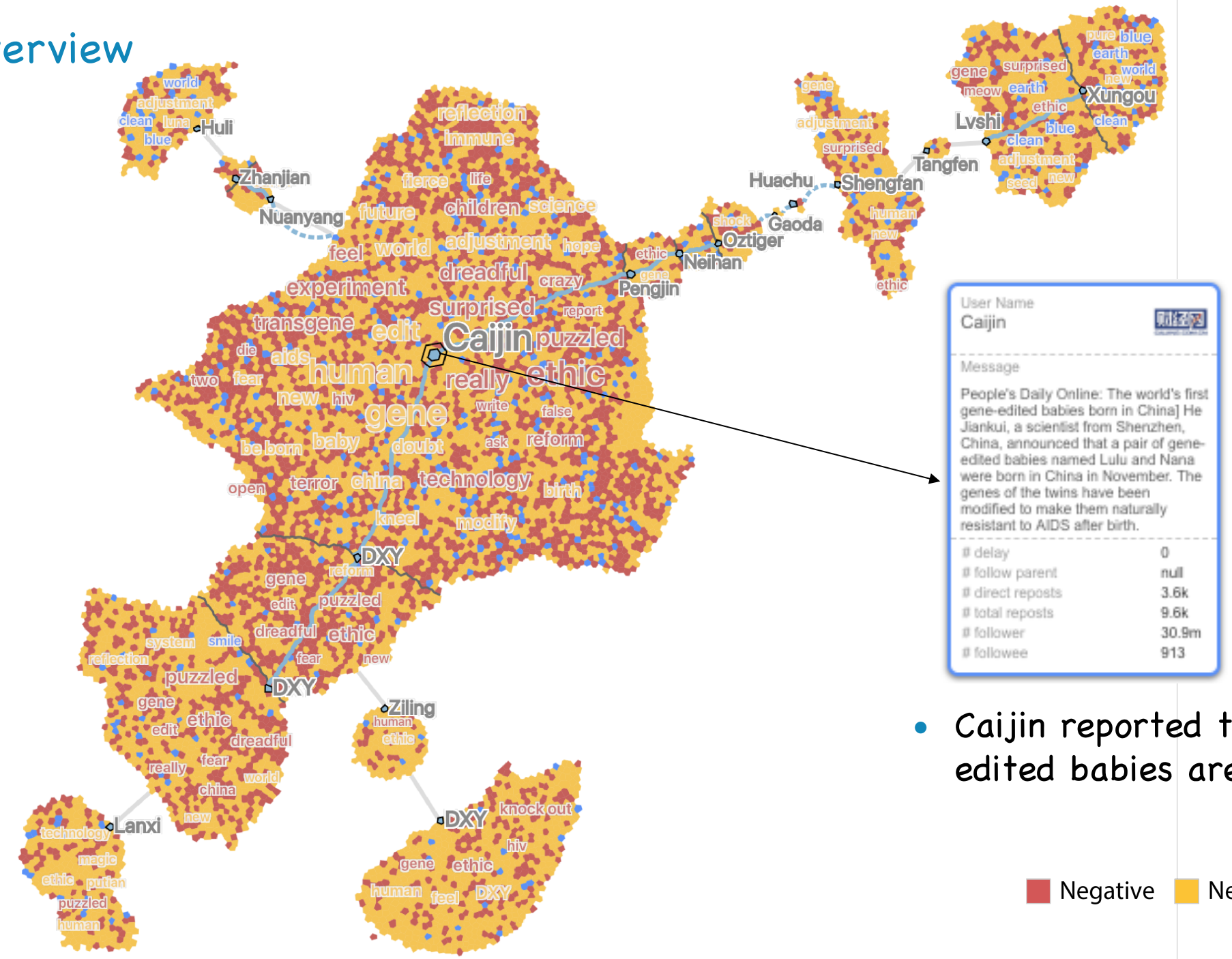
Pause Reset


child
Kanchai
appreciate
interview
Kanchai
pect
classmate
power
teacher
appreciate
Yaochen
hope
good
Little7
child
news
hour
weibo
like
support
fighting
sister
famous person
years
repost
student
friend
Kanchai
sir
students
Yaochen
Kanchai
interview
accept
child
Little7
Yaochen
interview
teacher
study
thanks
Little7
Yaochen
normal
awesome
appreciate
news
good
appointment
weibo
Little7
Yaochen
Sina
famous person
years
reporter
child
normal
mighty
homework
appointment
teacher
study
tear
success
era
applaud
both
right
sister
power
love
courage
cute
classmate
interview
chance
real
repost
Yaochen
support
great
student
moving
life
news
magical
haha
move
sincere
weibo
powerful
outline
Little7
yao
good
Praise
powerful
classmate
like
lucky
experience
dream
finally
dayao
envy
sincere
school
celebrity
in front of

Case 2: Sentiment and Semantics Interpretation

- Data
  - The news about gene-edited babies born in China
  - 9596 reposting weibos in total

Overview



User Name
Caijin

Message

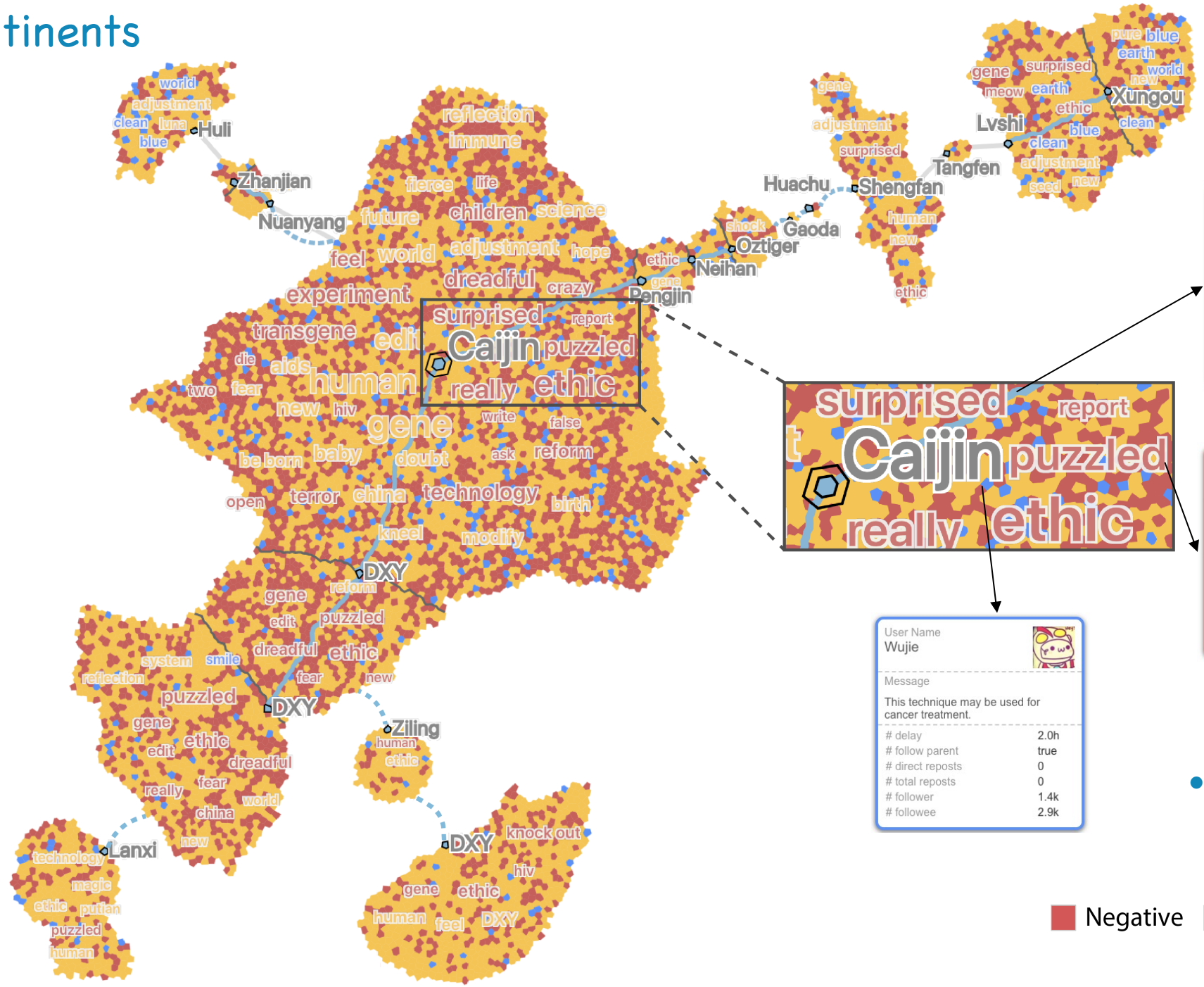
People's Daily Online: The world's first gene-edited babies born in China] He Jiankui, a scientist from Shenzhen, China, announced that a pair of gene-edited babies named Lulu and Nana were born in China in November. The genes of the twins have been modified to make them naturally resistant to AIDS after birth.

# delay	0
# follow parent	null
# direct reposts	3.6k
# total reposts	9.6k
# follower	30.9m
# followee	913

- Caijin reported the news "gene-edited babies are born in China"

Negative Neutral Positive

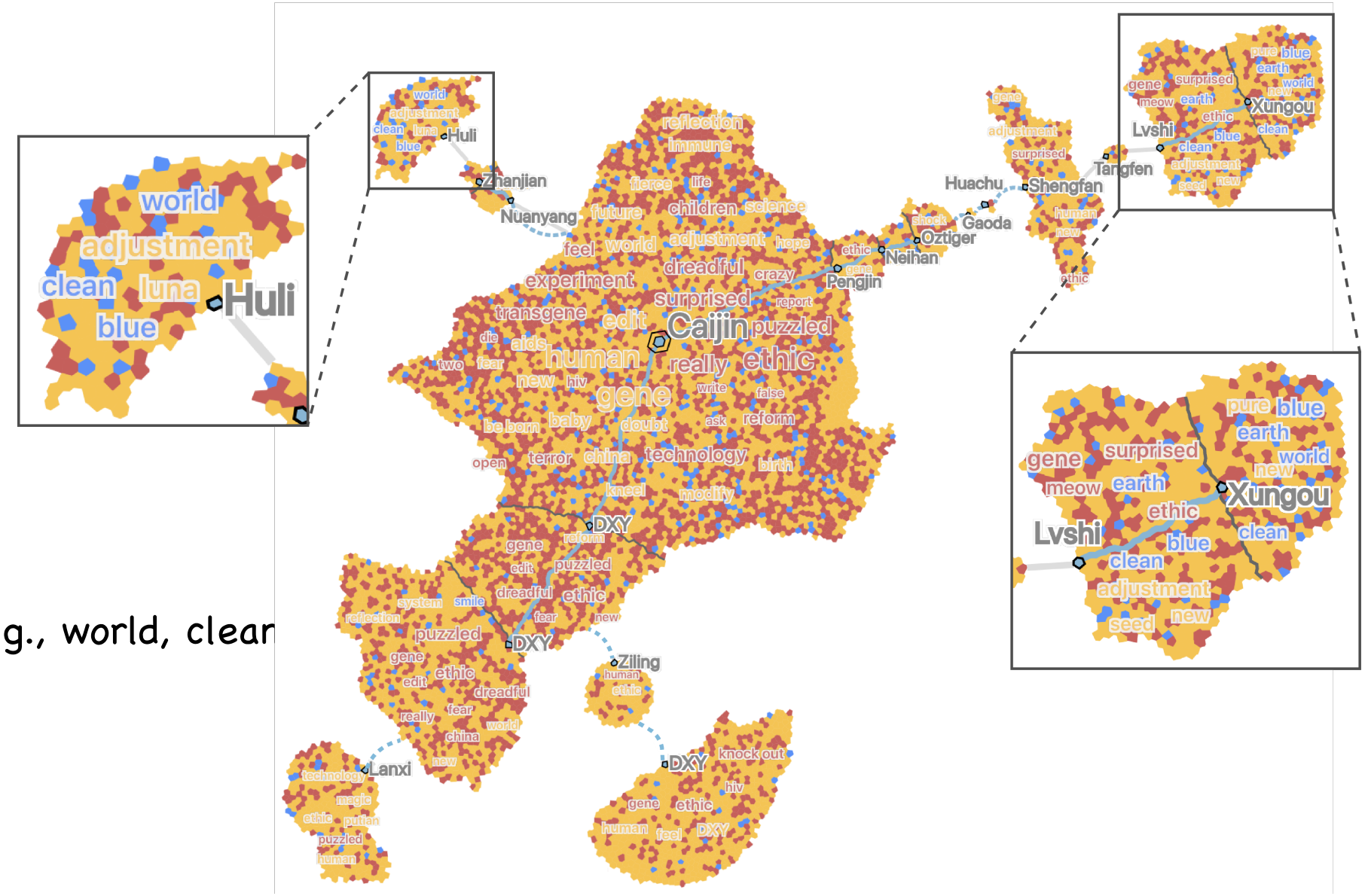
Continents



- Negative keywords, e.g., surprised, puzzled, ethic.

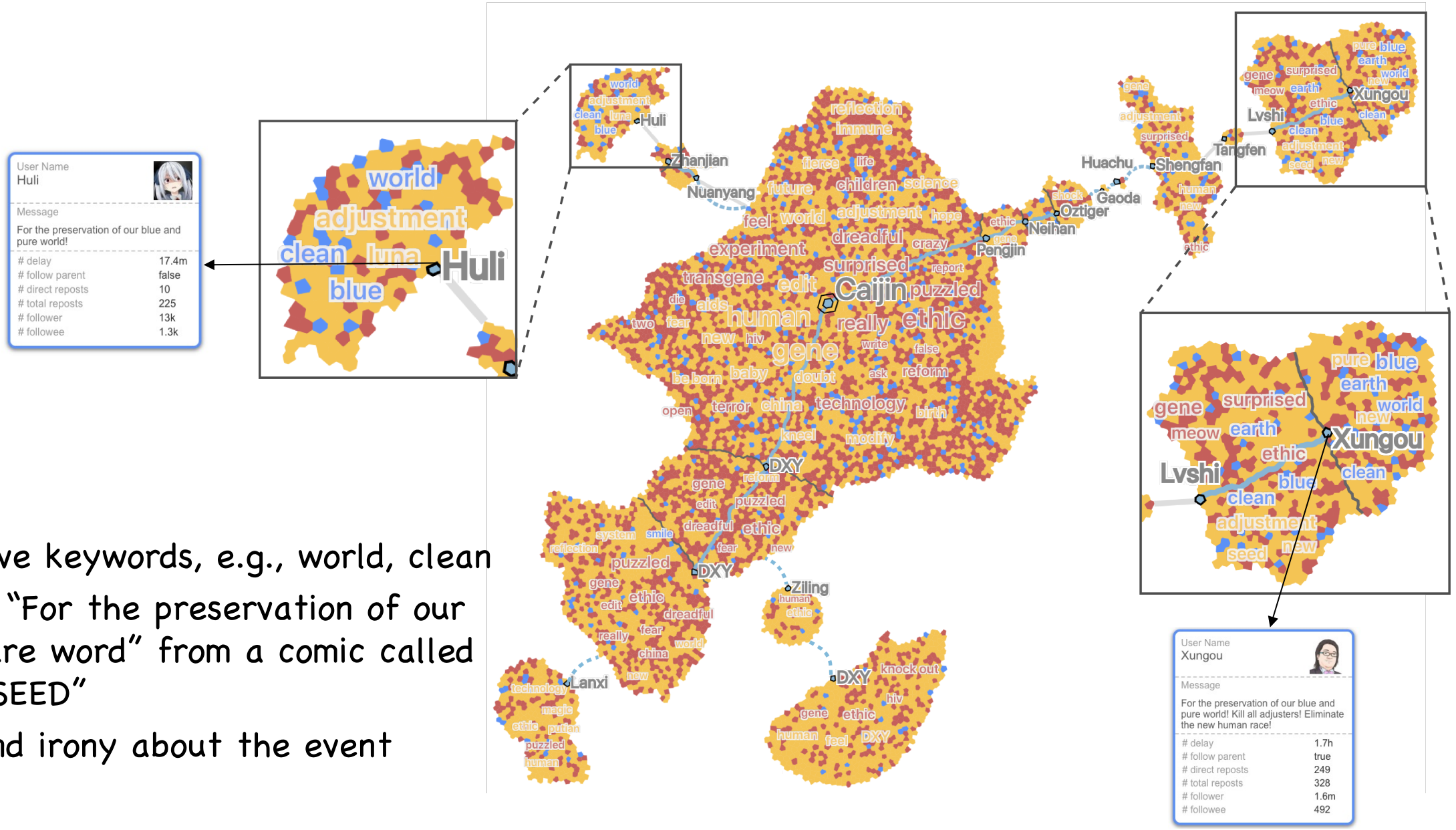
Negative Neutral Positive

Islands



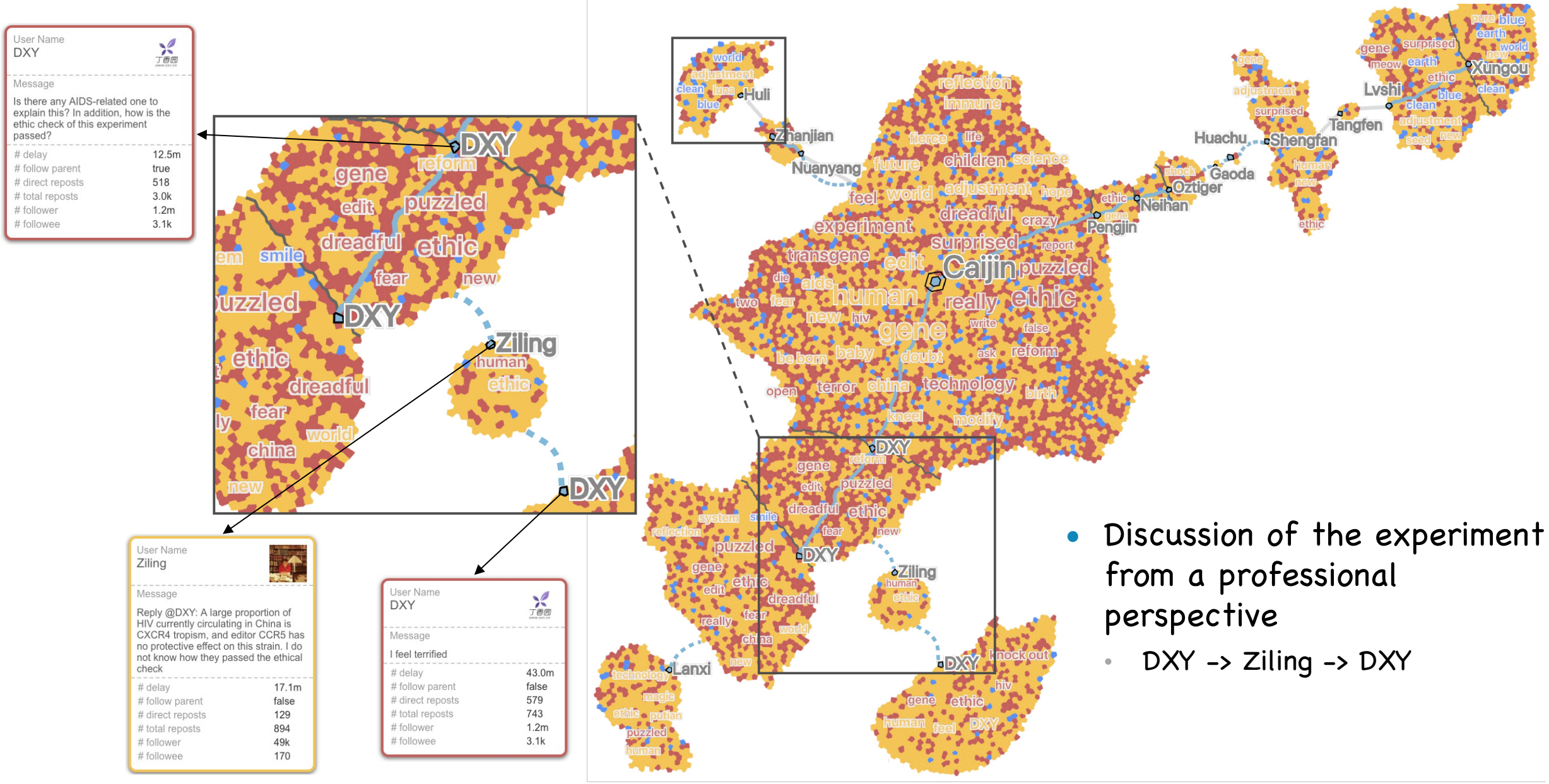
- Some positive keywords, e.g., world, clear blue

Islands

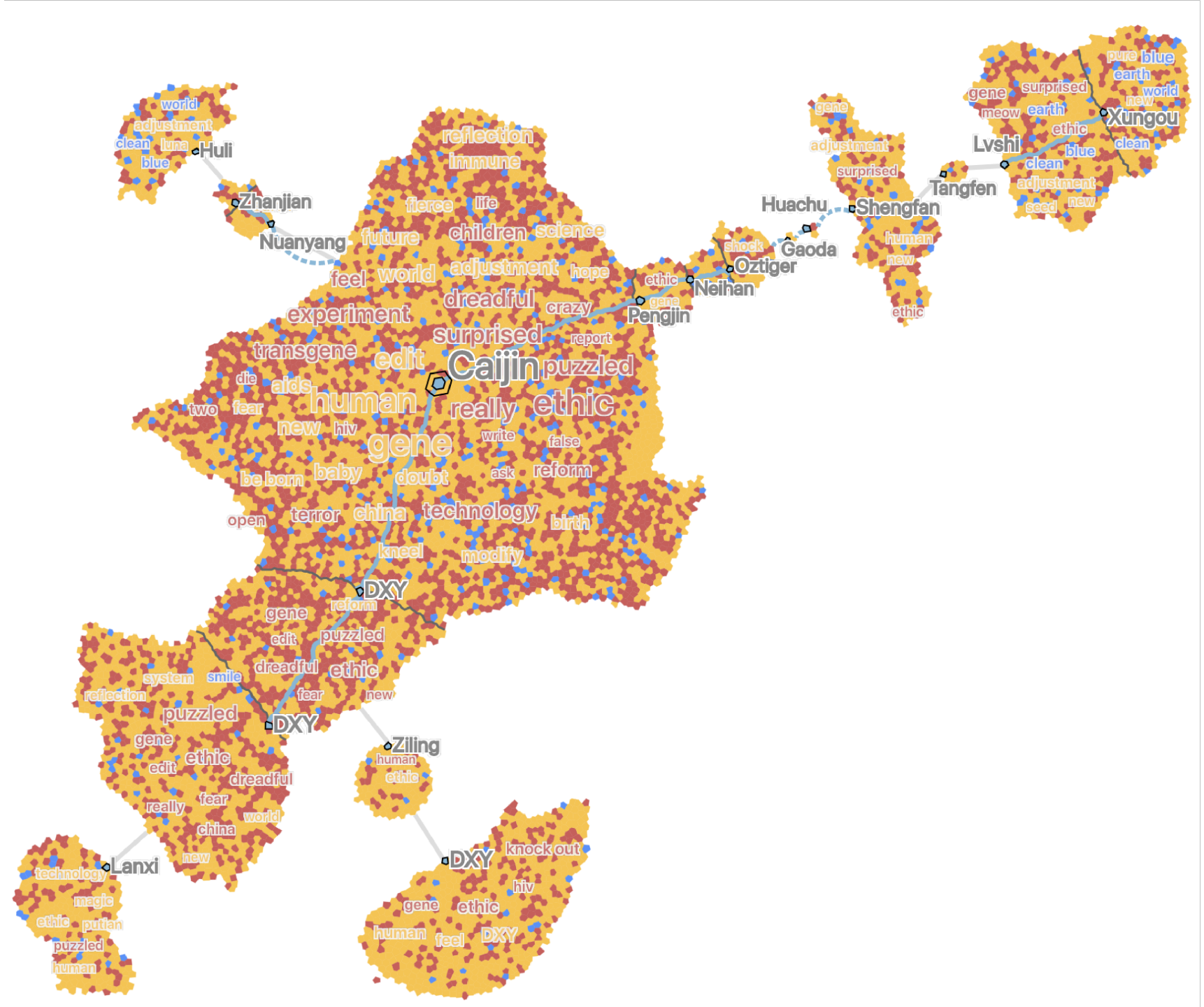


- Some positive keywords, e.g., world, clean
- The phrase "For the preservation of our blue and pure word" from a comic called "GUNDAM SEED"
- Concerns and irony about the event

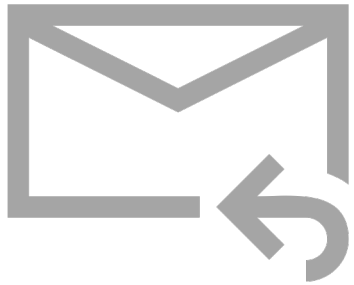
Key player's behaviors



- Discussion of the experiment from a professional perspective
  - DXY -> Ziling -> DXY


Huli
Zhanjian
Nuanyang
Caijin
Pengjin
Neihan
Oztiger
Gaoda
Huachu
Shengfan
Tangfen
Lvshi
Xungou
DXY
DXY
Ziling
DXY
Lanxi
reflection
immune
fierce
life
future
children
science
feel
world
adjustment
hope
dreadful
crazy
experiment
surprised
report
transgene
edit
puzzled
die
aids
human
really
ethic
two
fear
new
hiv
gene
write
false
be born
baby
doubt
ask
reform
open
terror
china
technology
birth
kneel
modify
reform
gene
edit
puzzled
dreadful
ethic
system
smile
reflection
fear
new
puzzled
gene
ethic
edit
dreadful
really
fear
world
china
new
technology
magic
ethic
putian
puzzled
human
human
ethic
gene
ethic
human
feel
DXY
knock out
hiv
shock
ethic
gene
human
new
ethic
surprised
adjustment
gene
meow
earth
surprised
pure
blue
earth
world
new
ethic
blue
clean
clean
adjustment
seed
new
world
adjustment
clean
luna
blue

Questions?
Thank you ☺



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