

CIS 4930/6930-002

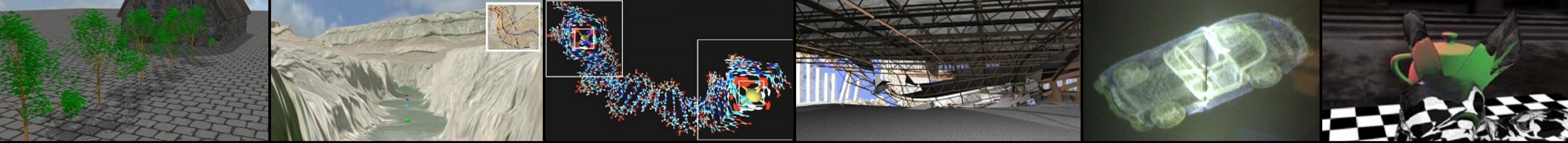
DATA VISUALIZATION



SINGLE VIEW, MULTIVIEW, & FOCUS+CONTEXT

Paul Rosen
Assistant Professor
University of South Florida

slides credits Miriah Meyer (U of Utah)



REMINDERS

2/19/2018 – Project 4 due

2/21/2018 – Paper Review 2 Due



SINGLE VS MULTIPLE VIEWS

eyes over memory—trade-off of display space and working memory

similar situation with partitioning vs layering



A VARIETY OF OPTIONS...

④ Juxtapose and Coordinate Multiple Side-by-Side Views

→ Share Encoding: Same/Different

→ *Linked Highlighting*



→ Share Data: All/Subset/None



→ Share Navigation



| | | Data | | |
|----------|-----------|---|---|---|
| | | All | Subset | None |
| Encoding | Same | Redundant |  Overview/ Detail |  Small Multiples |
| | Different |  Multiform |  Multiform, Overview/ Detail | No Linkage |

⑤ Partition into Side-by-Side Views



⑥ Superimpose Layers



LINKED VIEWS

multiple views that are simultaneously visible and linked together such that actions in one view affect the others



WHAT TO SHOW

encoding: same or multiform

dataset: share all, subset, or none

HOW TO INTERACT

highlighting: to link, or not

navigation: to share, or not



MULTIFORM

different visual encodings are used between the views

rational: single, monolithic view has strong limits on the number of attributes that can be shown simultaneously





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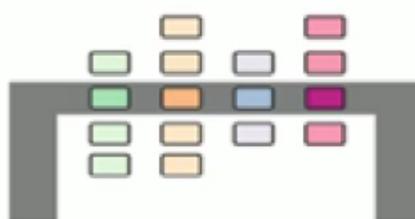
VisBricks: Multiform Visualization of Large, Inhomogeneous Data

caleydotugraz

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VisBricks: Multiform Visualization of Large, Inhomogeneous Data

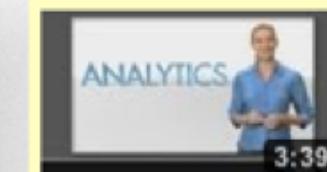


Alexander Lex, Hans-Jörg Schulz, Marc Streit,
Christian Partl and Dieter Schmalstieg



Uploaded by [caleydotugraz](#) on Jul 12, 2011

Large volumes of real-world data often exhibit inhomogeneities: vertically in the form of correlated or independent dimensions, horizontally in the form of clustered or scattered data items. In essence, these inhomogeneities form



Put Text Into Usable Data

by SASsoftware
5,776 views

Ad



Will Hunsinger shows off Evri

by TechFlashVideos
158 views



Information Visualization

by UTHealthSBMI
183 views



code_swarm - A Design Study in Organic

by michaelogawa
190 views



Caleydo Matchmaker Commercial

by caleydotugraz
172 views



Model-Driven Design for the Visual Analysis of ...

by caleydotugraz
109 views



The Caleydo Jukebox

[HTTPS://WWW.YOUTUBE.COM/WATCH?V=_5J80uDTxD8](https://www.youtube.com/watch?v=_5J80uDTxD8)



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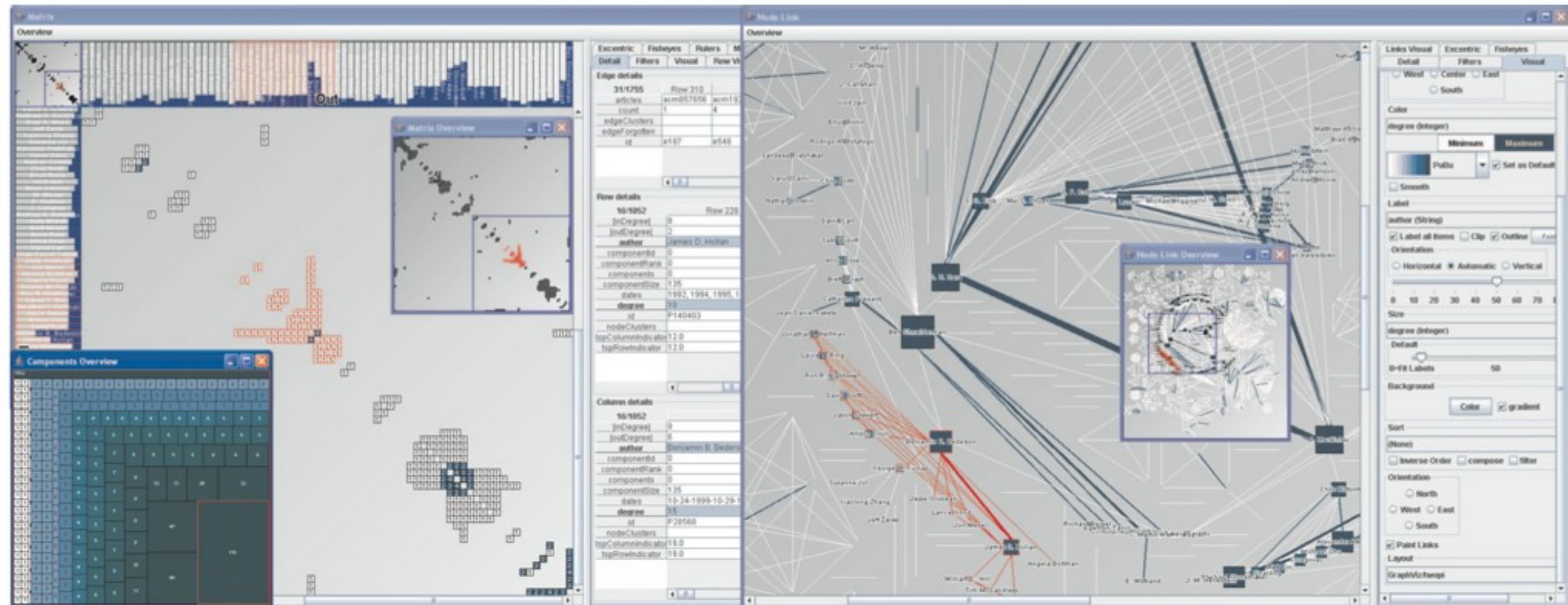
SHARED DATA

showing all data in each view, but with different
encoding schemes

rational: different views support different tasks



MATRIXEXPLORER



Henry 2006

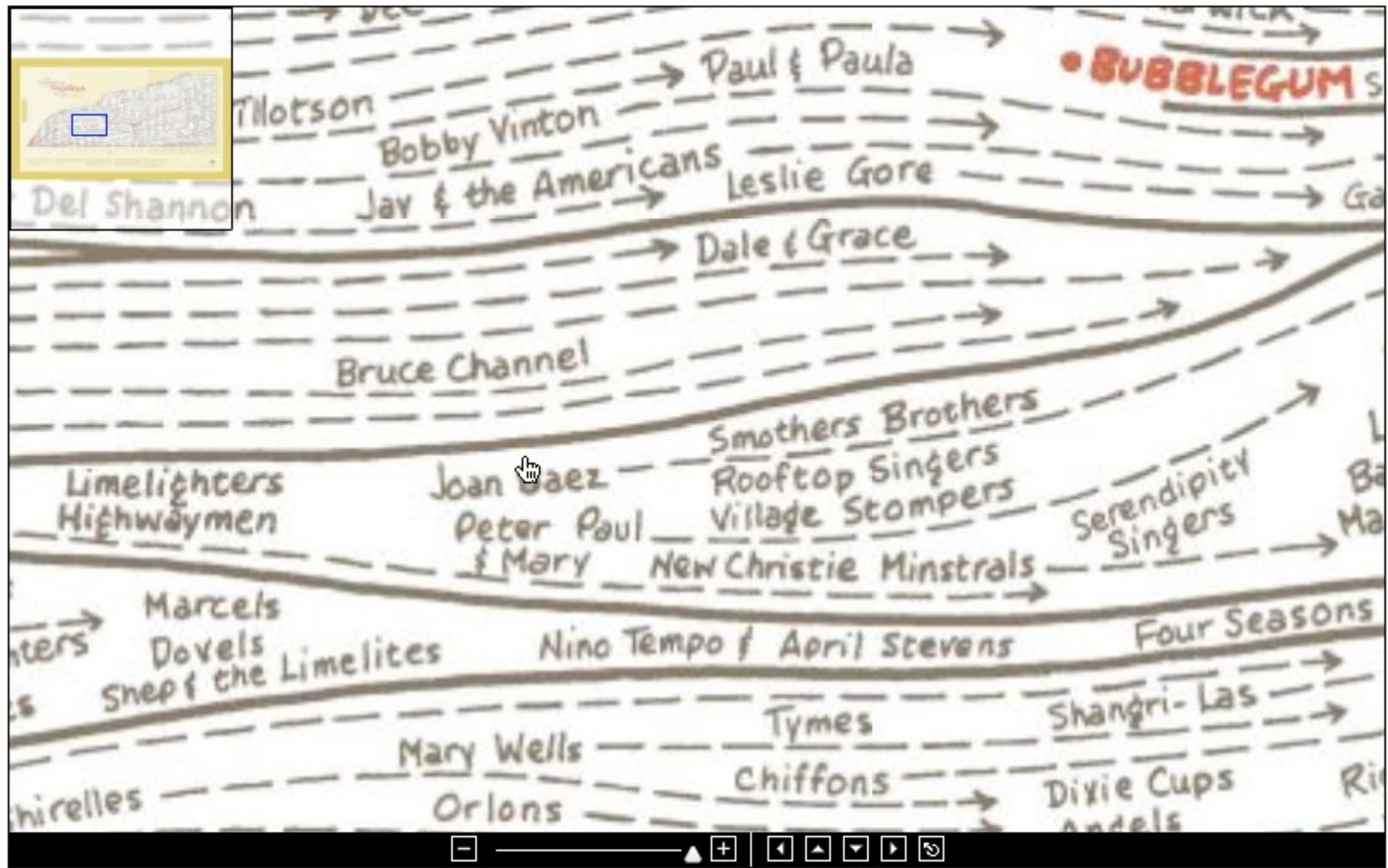


OVERVIEW + DETAIL

one view shows (often summarized) information about entire dataset, while additional view(s) shows more detailed information about a subset of the data

rational: for large or complex data, a single view of the entire dataset cannot capture fine details



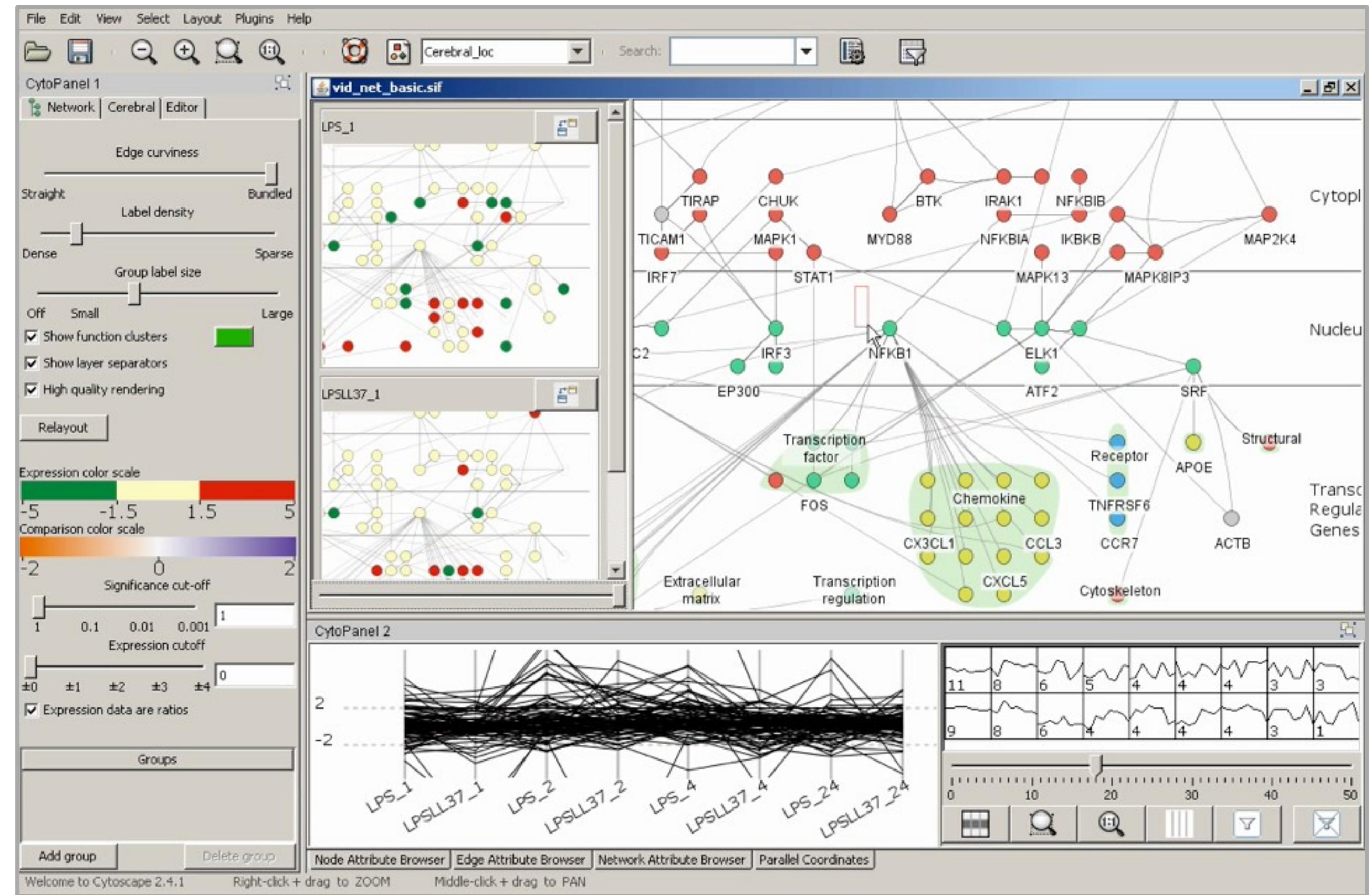


SMALL MULTIPLES

each view uses the same visual encoding, but shows a different subset of the data

rational: quickly compare different parts of a data set, relying on eyes instead of memory





| | | Shared Data | | |
|-----------------|-----------|--|--|---|
| | | All | Subset | None |
| Shared Encoding | Same |  Redundant |  Overview/ Detail |  Small Multiples |
| | Different |  Multiform |  Multiform, Overview/ Detail |  No Linkage |



WHAT TO SHOW

encoding: same or multiform

dataset: share all, subset, or none

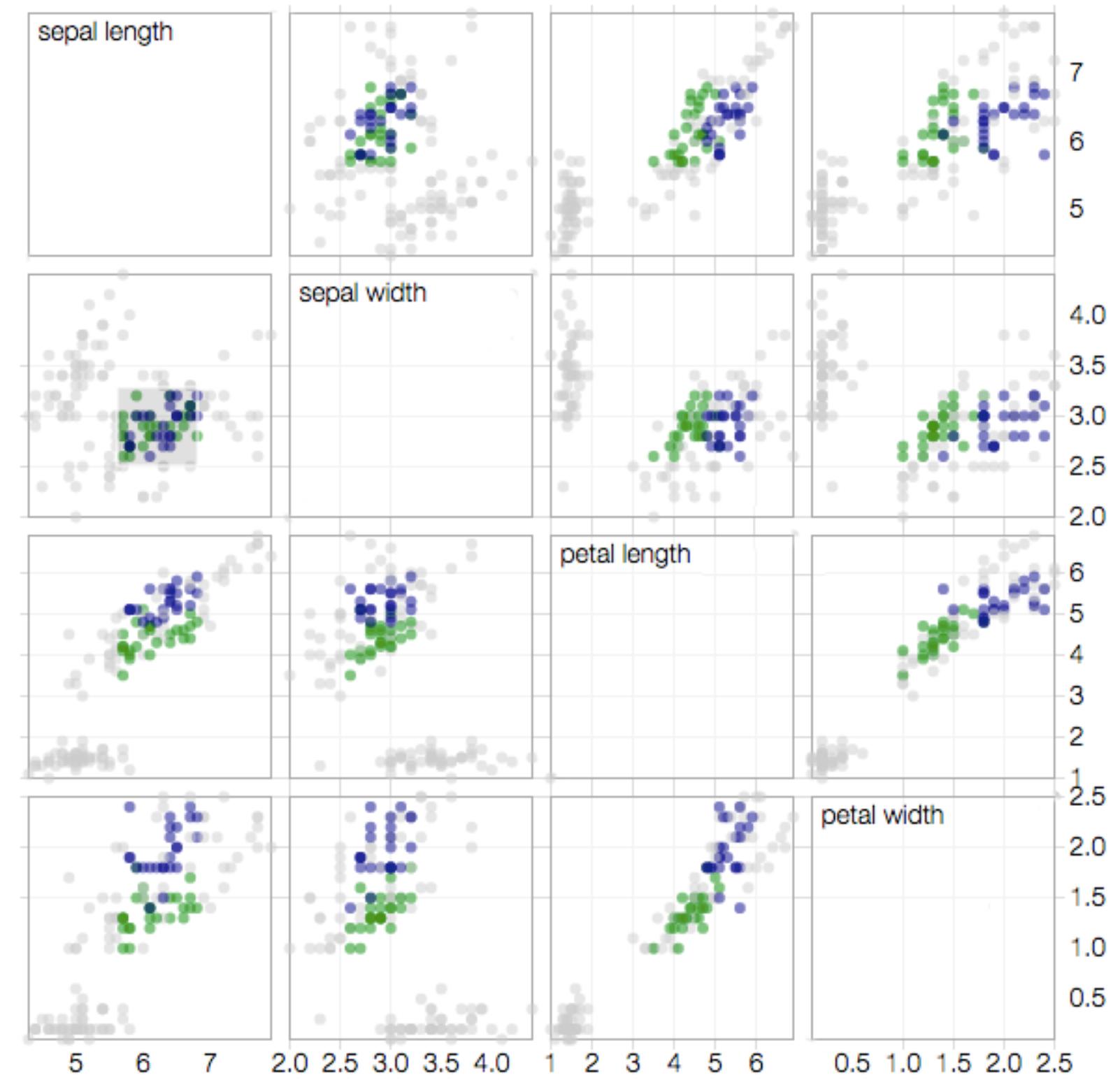
HOW TO INTERACT

highlighting: to link, or not

navigation: to share, or not



LINKED HIGHLIGHTING



WHAT TO SHOW

encoding: same or multiform

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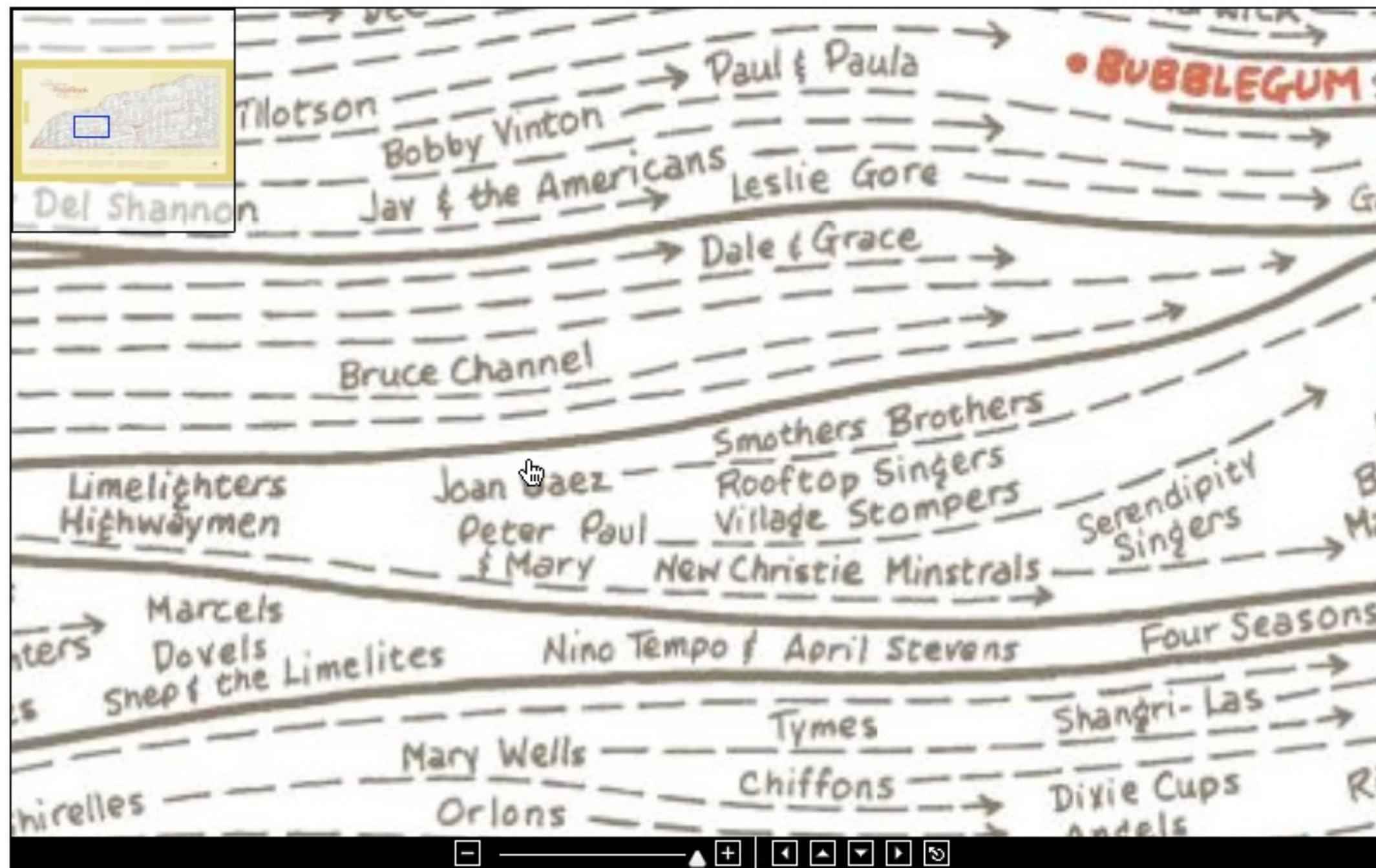
HOW TO INTERACT

highlighting: to link, or not

navigation: to share, or not



LINKED NAVIGATION



A VARIETY OF OPTIONS...

④ Juxtapose and Coordinate Multiple Side-by-Side Views

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④ Partition into Side-by-Side Views



④ Superimpose Layers



PARTITIONING

action on the dataset that separates the data into groups

main design choices

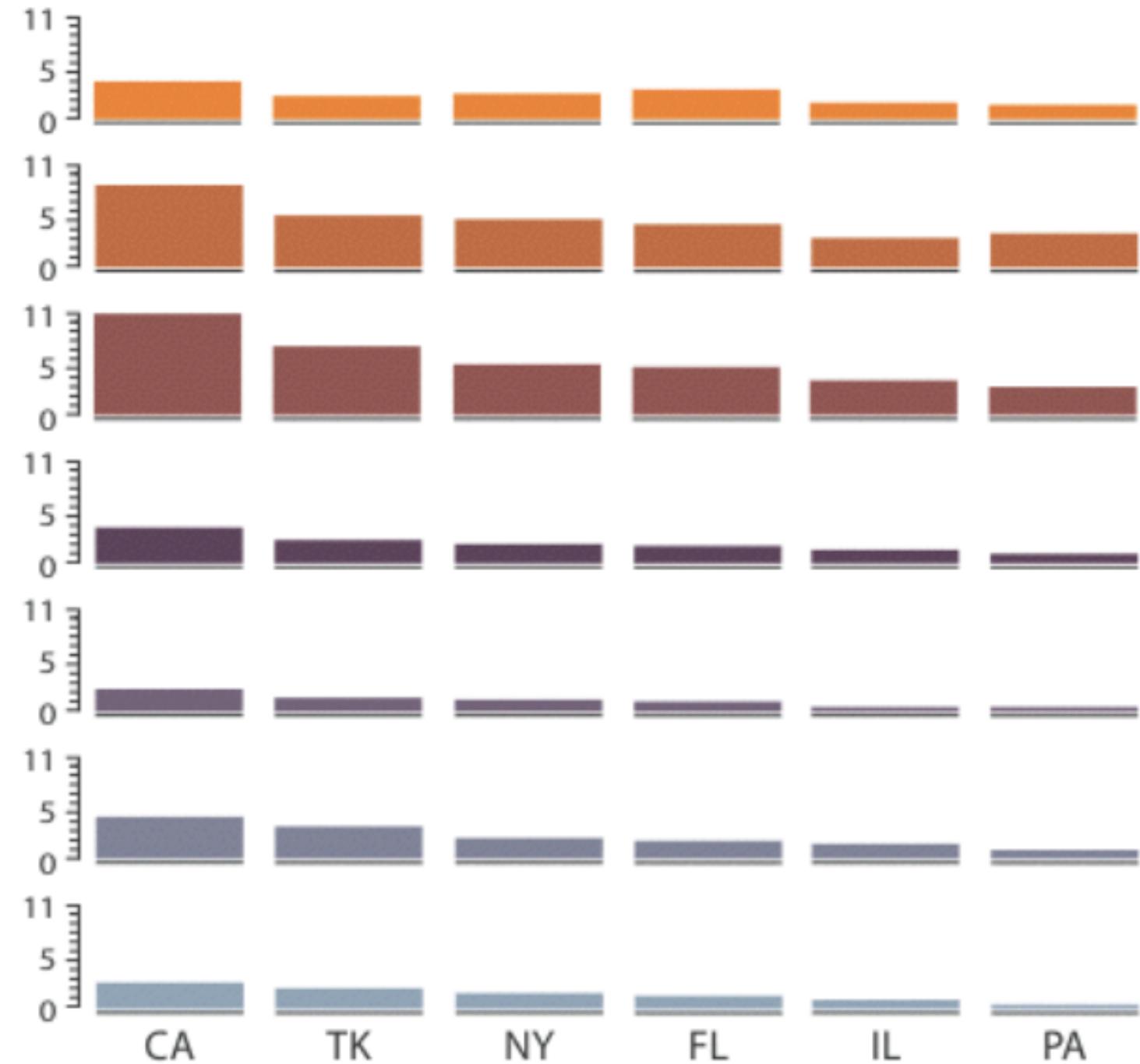
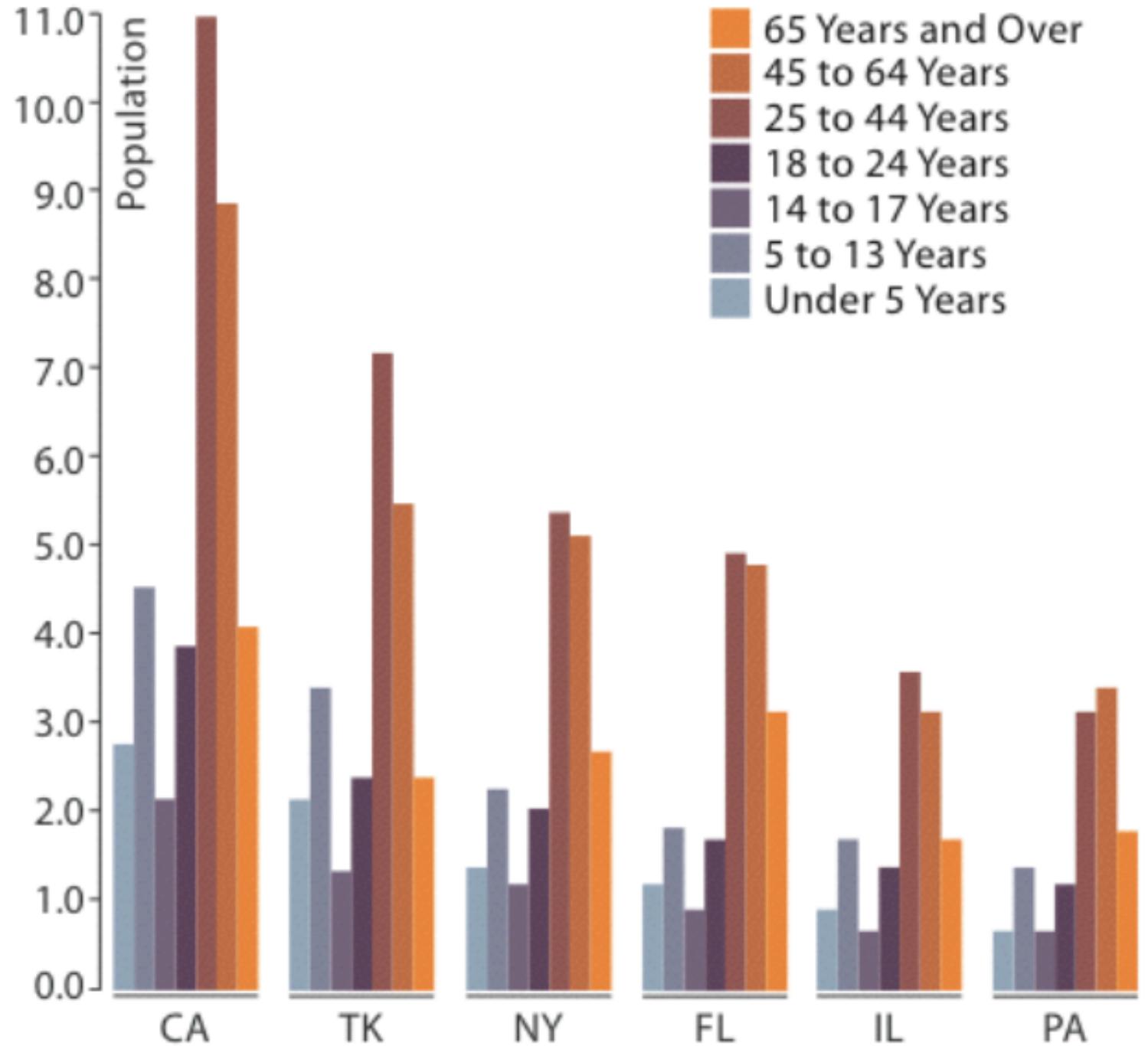
how to divide data up between views, given a hierarchy of attributes

how many splits, and order of splits how many views (usually data driven)

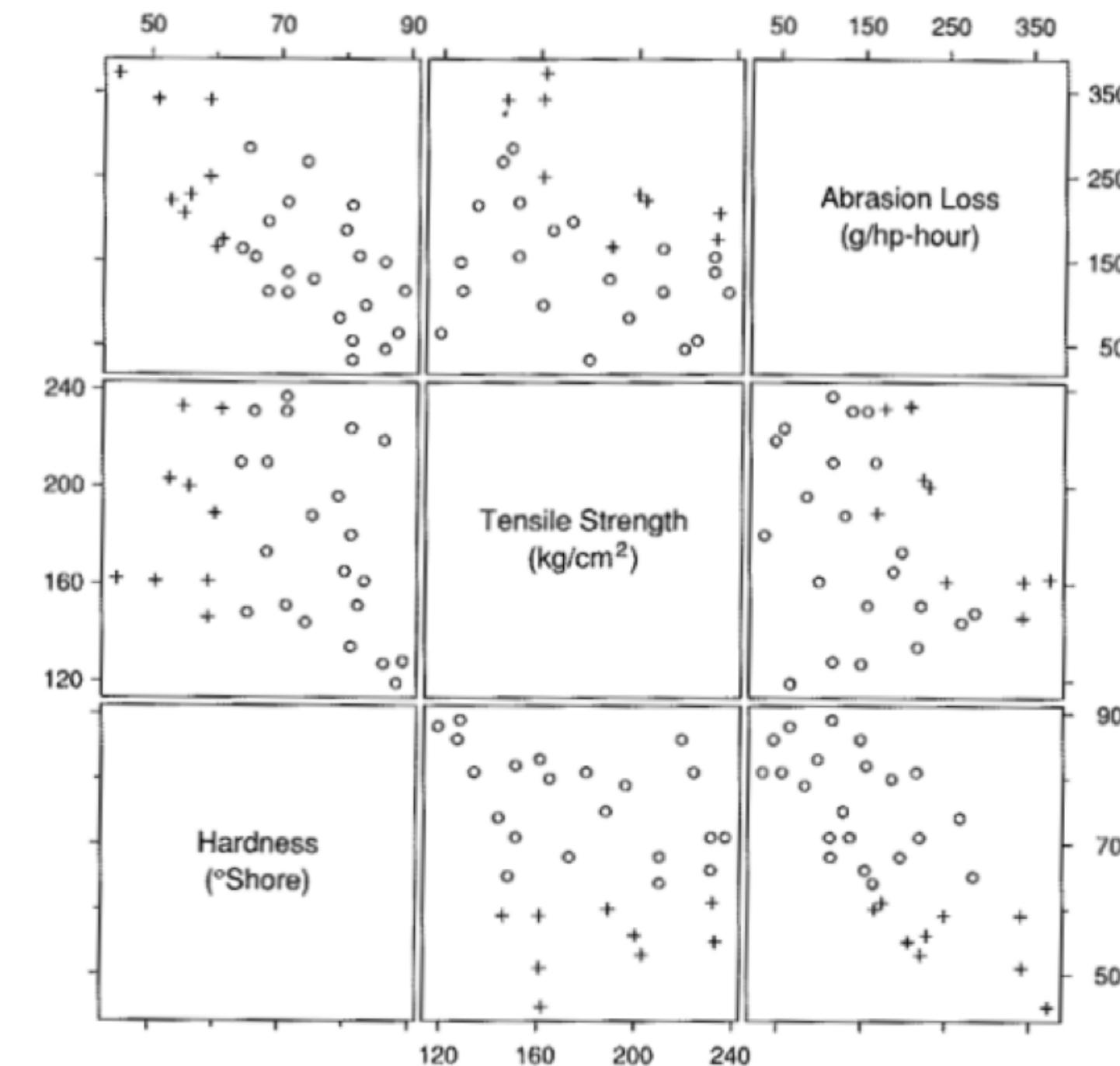
partition attribute(s)

typically categorical





SCATTERPLOT MATRIX (SPLOM)



3.65 CONDITIONING. A scatterplot matrix displays trivariate data: measurements of abrasion loss, hardness, and tensile strength for 30 rubber specimens. The "+" plotting symbols encode the data for those specimens with hardness less than 62 °Shore.



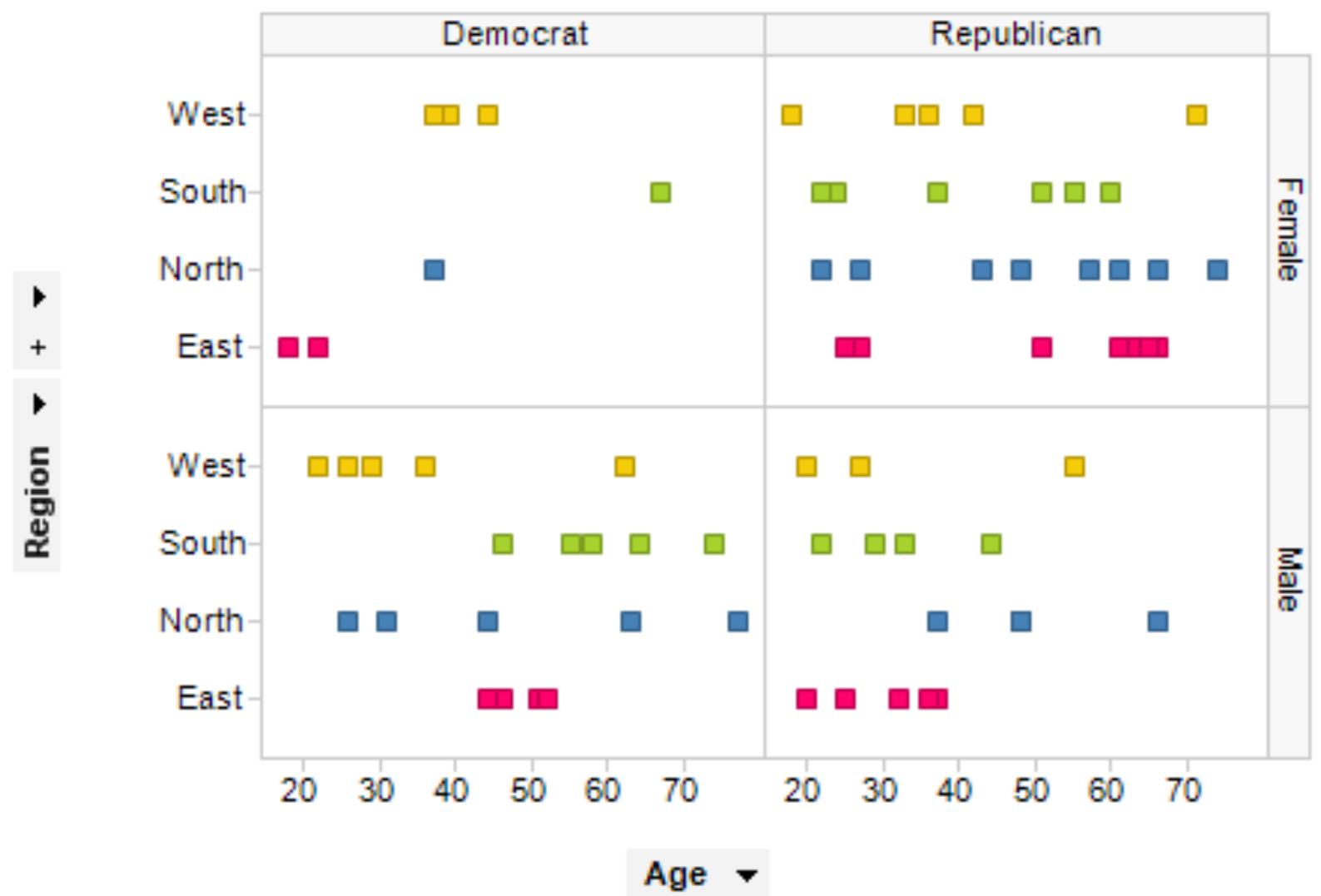
TRELLISED VIEWS

panel variables: attributes encoded in individual views

partitioning variables: partitioning attributes assigned
to columns, rows, and pages



trellising this visualization based on
Gender and Political affiliation



HIVE: HIERARCHICAL VISUAL EXPRESSION

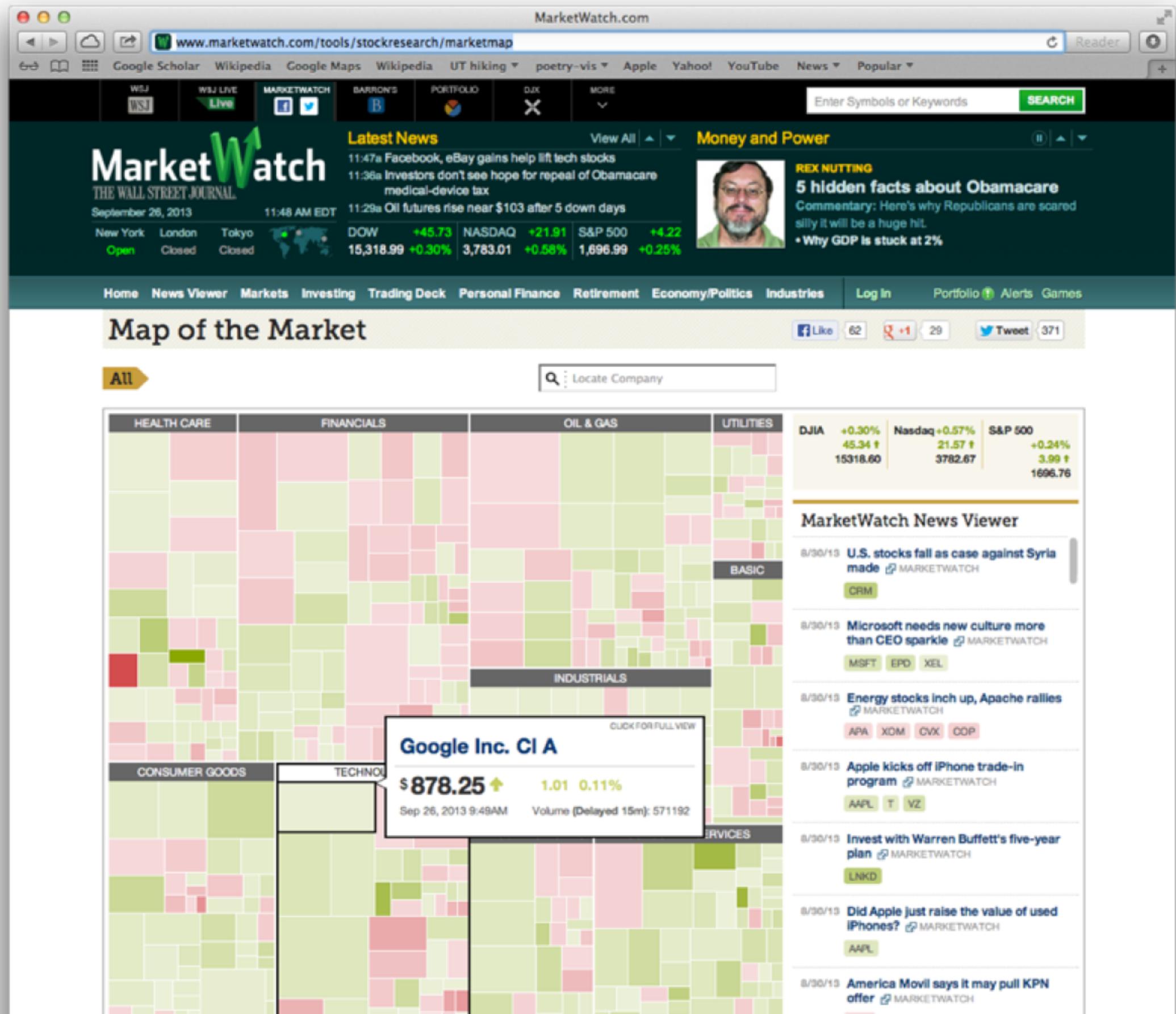
partitioning: transform data attributes into a hierarchy

reconfigure hierarchies to explore data space

treemaps used as spacefilling layouts



TREEMAP

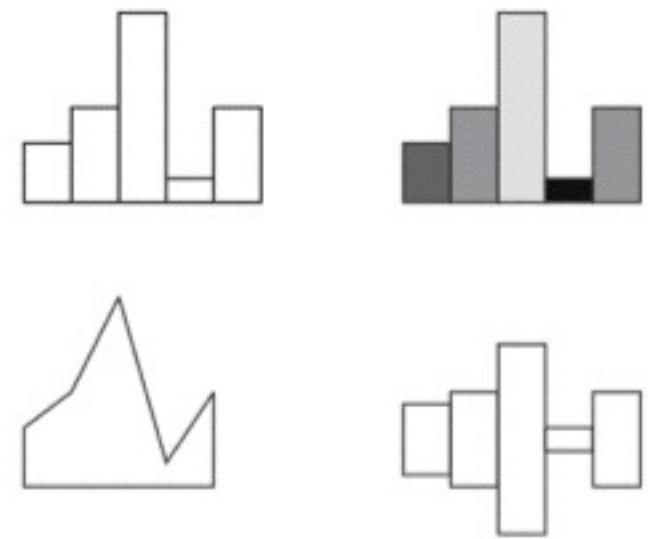


GLYPHS

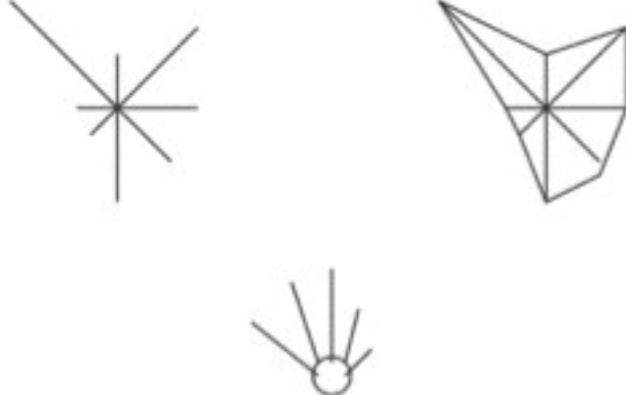
a graphical object with internal structure that arises
from multiple marks

ambiguity: little distinct line between glyph and view!

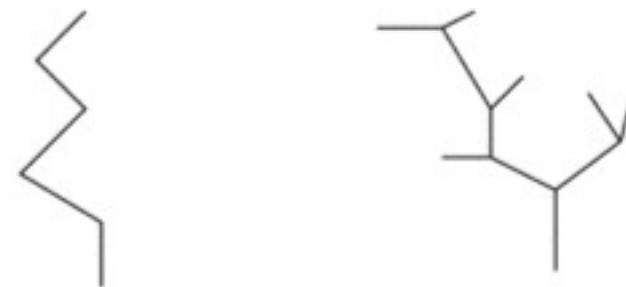




Variations on Profile glyphs



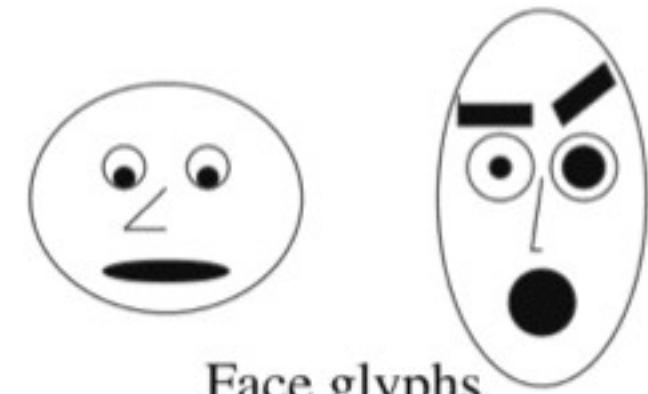
Stars and Anderson/metroglyphs



Sticks and Trees



Autoglyph and box glyph

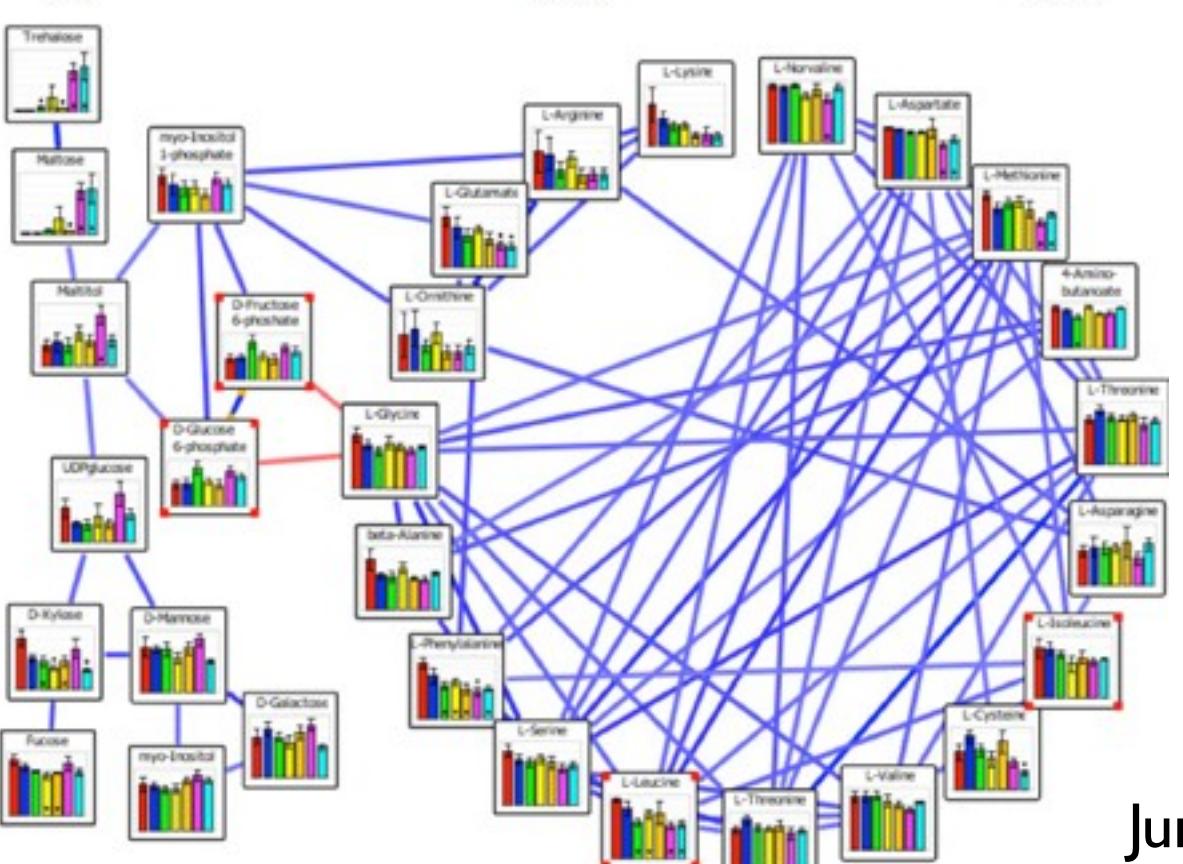
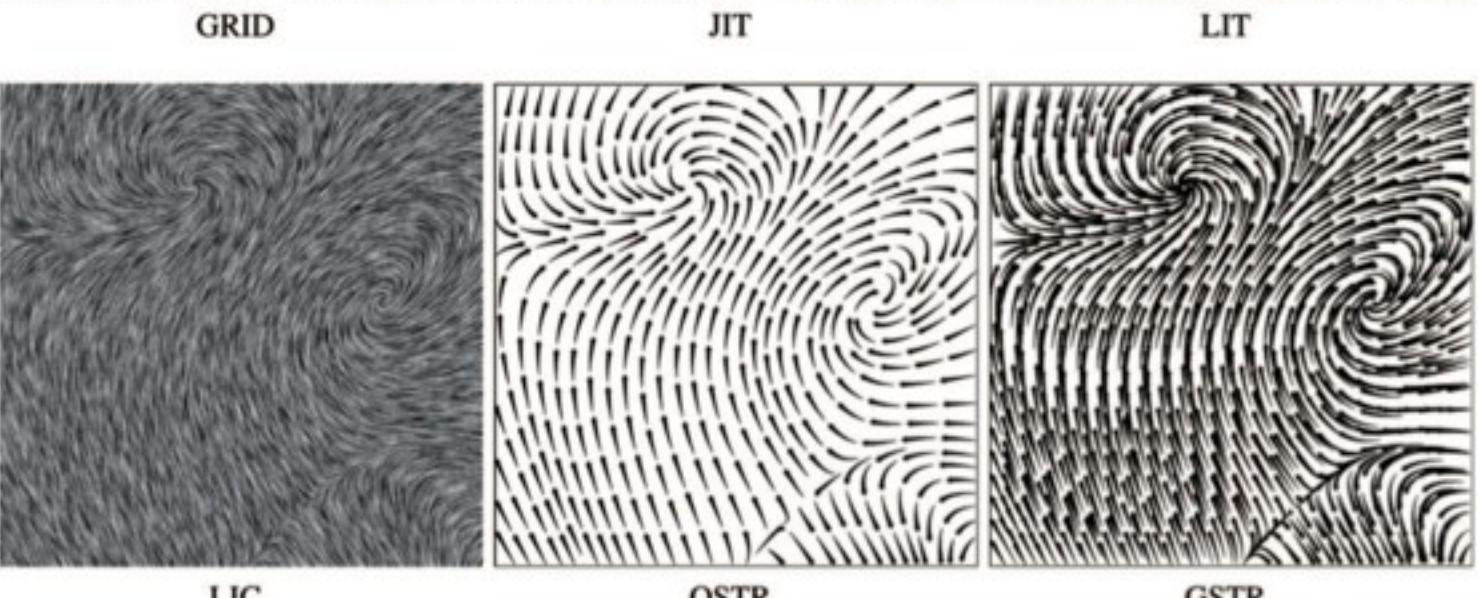
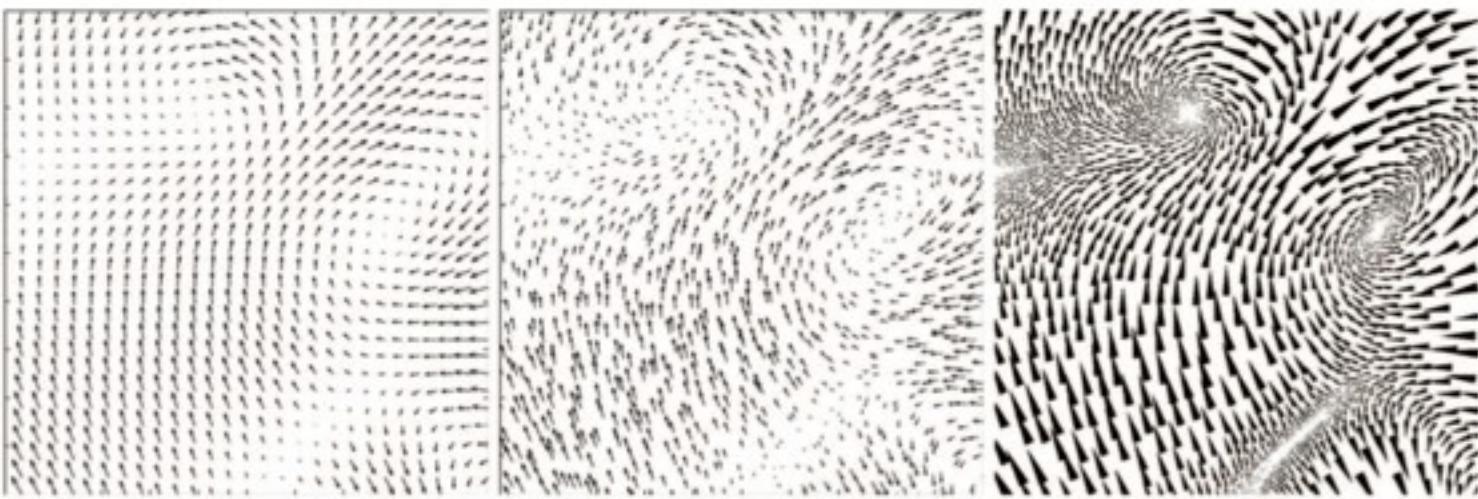


Face glyphs

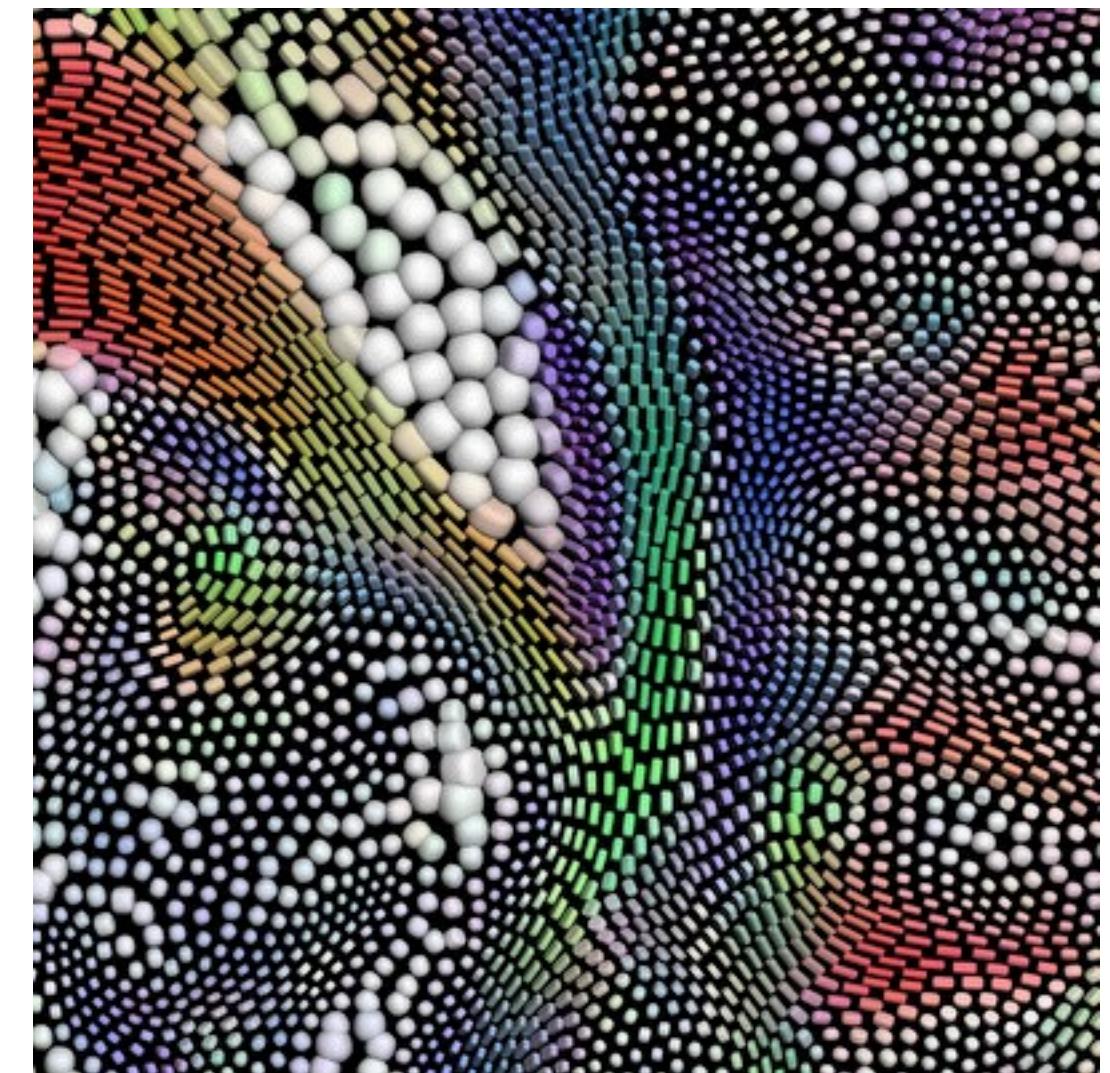


Arrows and Weathervanes





Junker 2006



Kindlmann 2006



PROCESS

gather metadata for obtaining a set of names
or, things you want to represent

build a taxonomy

propose several categorization schemes

develop visual design

determine order of visual channels

propose optional mappings

identify metaphoric abstractions

implement a glyph-based system



| | design option 1 | design option 2 | design option 3 | design option 4 | design option 5 | design option 6 | design option 7 |
|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Inputs and Outputs | ■ | ● | □ | ○ | □ | ● | |
| Process | ■ | ■ | □ | ● | □ | ■ | |
| Biological | ■ | ▲ | □ | ○ | □ | ◆ | |
| Device | ■ | ● | □ | ● | □ | ◆ | |
| Chemical | ■ | ◆ | □ | ● | □ | ▼ | |
| Data | ■ | ■ | □ | ● | □ | ■ | |
| In Vitro | ■ | ● | □ | ● | □ | ■ | ○ |
| In Vivo | ■ | ◆ | □ | ● | □ | ● | ○ |
| In Silico | ■ | ■ | □ | ○ | □ | □ | ■ |
| Data Collection | ■ | ■ | — | ▼ | — | ▼ | ◀ |
| Data Processing | ■ | ◆ | — | — | ▶ | ▶ | ▶ |
| Data Analysis | ■ | ● | ~ | ~ | ■ | ▲ | |
| Material perturbation | ■ | ■ | • | ○ | — | ■ | ◇ |
| Material separation | ■ | ◆ | • | ● | — | — | ○ |
| Material amplification | ■ | ● | • | ● | — | — | ○ |
| Material combination | ■ | ■ | • | ● | — | — | ○ |
| Material collection | ■ | ▲ | ● | ● | — | — | ○ |
| Molecule | ■ | ■ | • | ~ | ○ | △ | ▲ |
| Cellular Part | ■ | ◆ | • | ○ | ○ | △ | ▲ |
| Cell | ■ | ● | • | ○ | ○ | △ | ◆ |
| Tissue | ■ | ■ | • | ○ | ▲ | △ | ▲ |
| Organ | ■ | ▲ | ● | ○ | ▼ | △ | ▼ |
| Organism | ■ | ★ | ● | ● | ▲ | △ | ▲ |
| Population | ■ | ■ | ● | ● | ▲ | △ | ▲ |
| Material | ■ | — | — | ○ | ■ | — | — |



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④ Partition into Side-by-Side Views



④ Superimpose Layers



LAYERING

combining multiple views on top of one another to form a composite view

rational: supports a larger, more detailed view than using multiple views

trade-off: layering imposes constraints on visual encoding choice as well as number of layers that can be shown

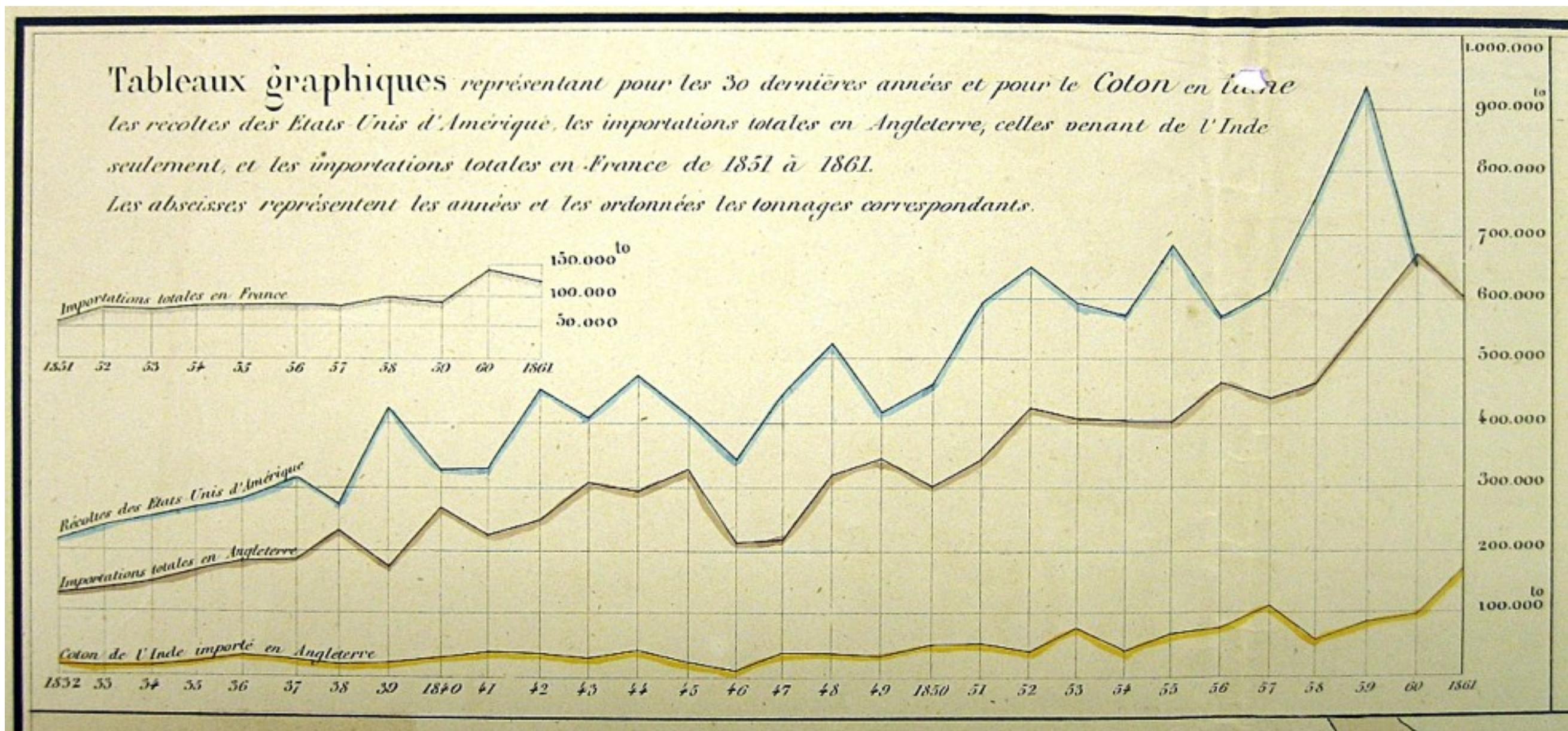


GLOBAL COMPOSITING

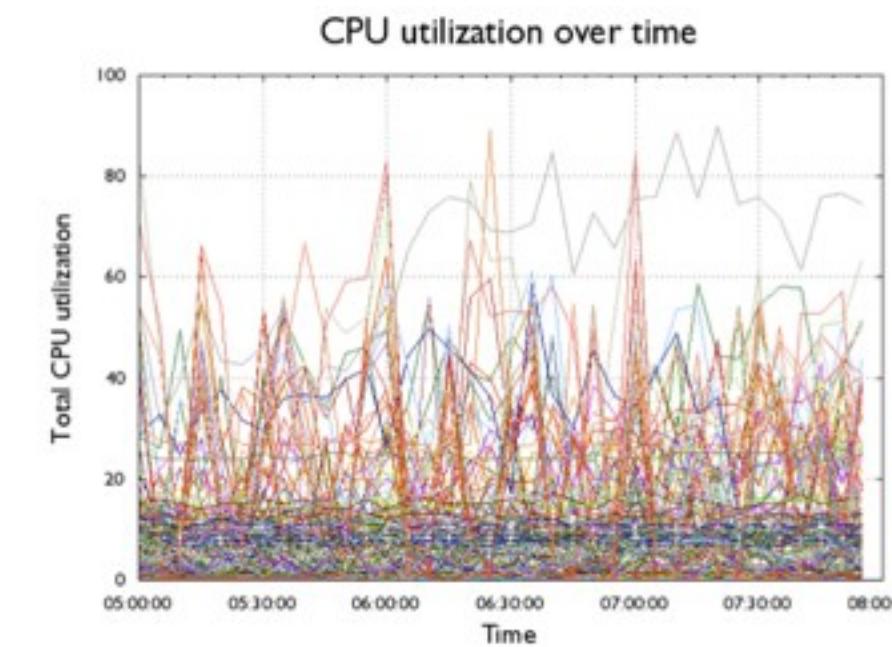
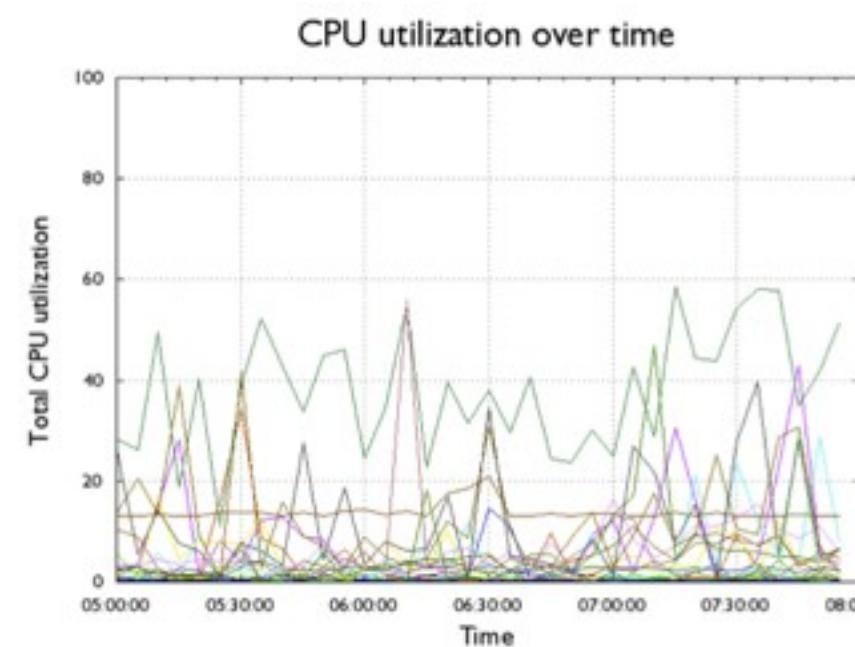
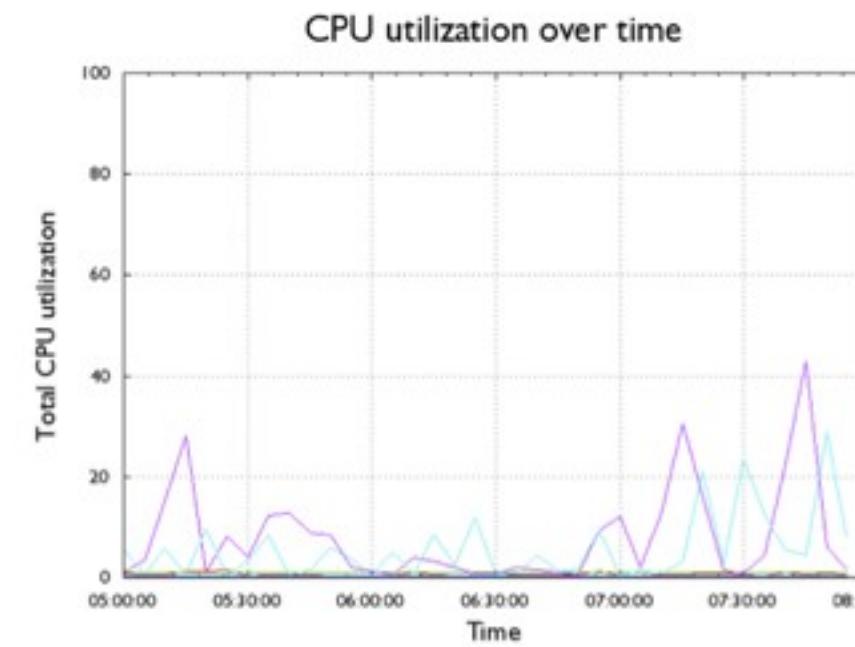


JOSEPH MINARD

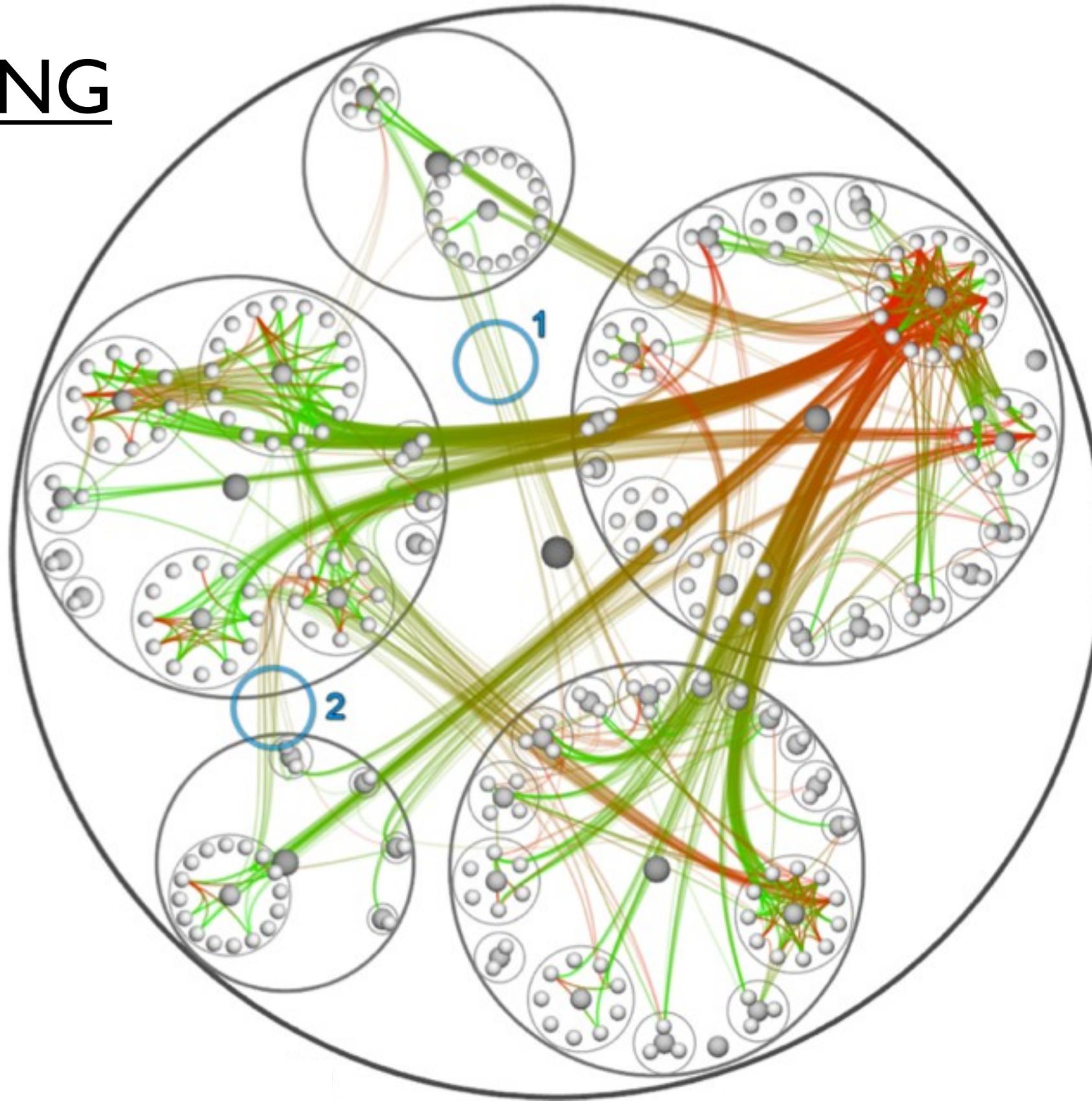
1781-1870



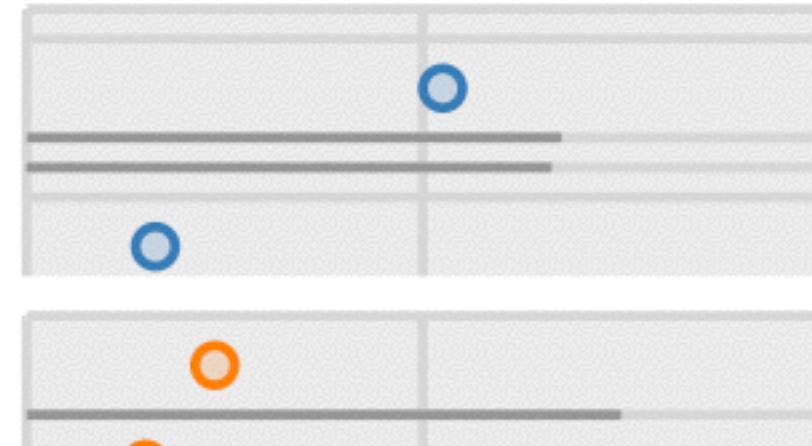
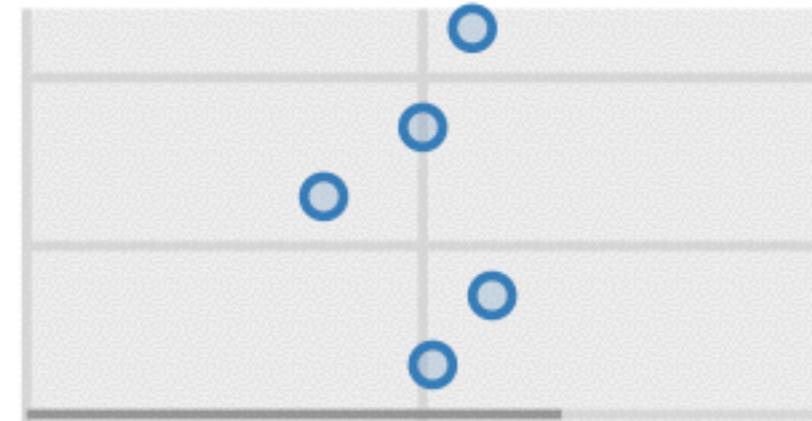
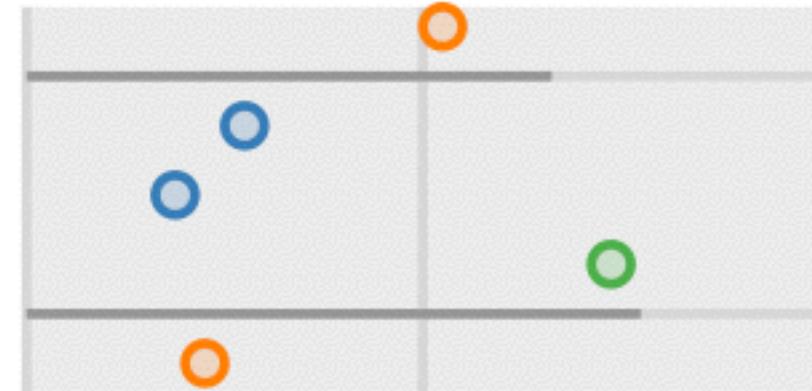
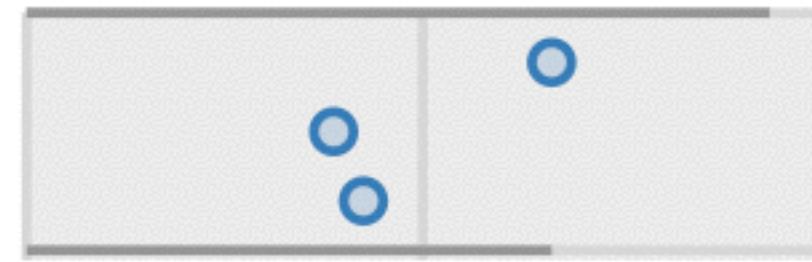
OVERLAYS



EDGE BUNDLING



MULTIPLE ENCODINGS

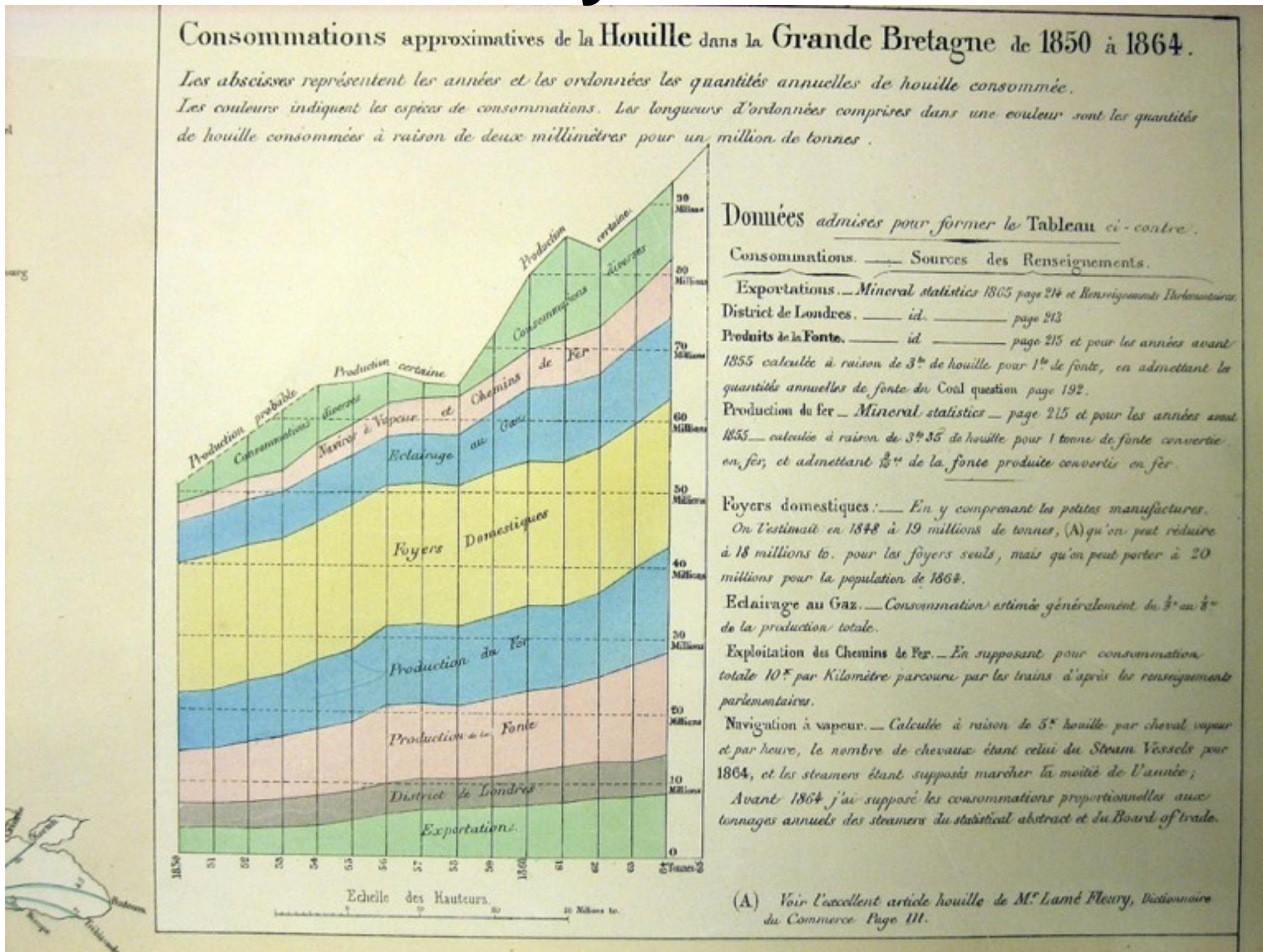


ITEM-LEVEL STACKING

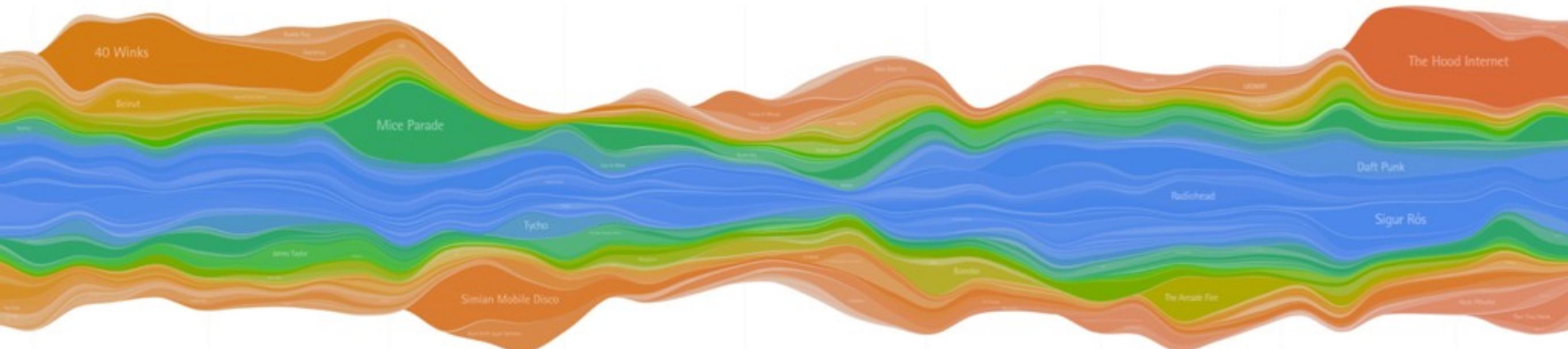


1781-1870

JOSEPH MINARD



STREAMGRAPH



Byron 2008



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Financial Tools

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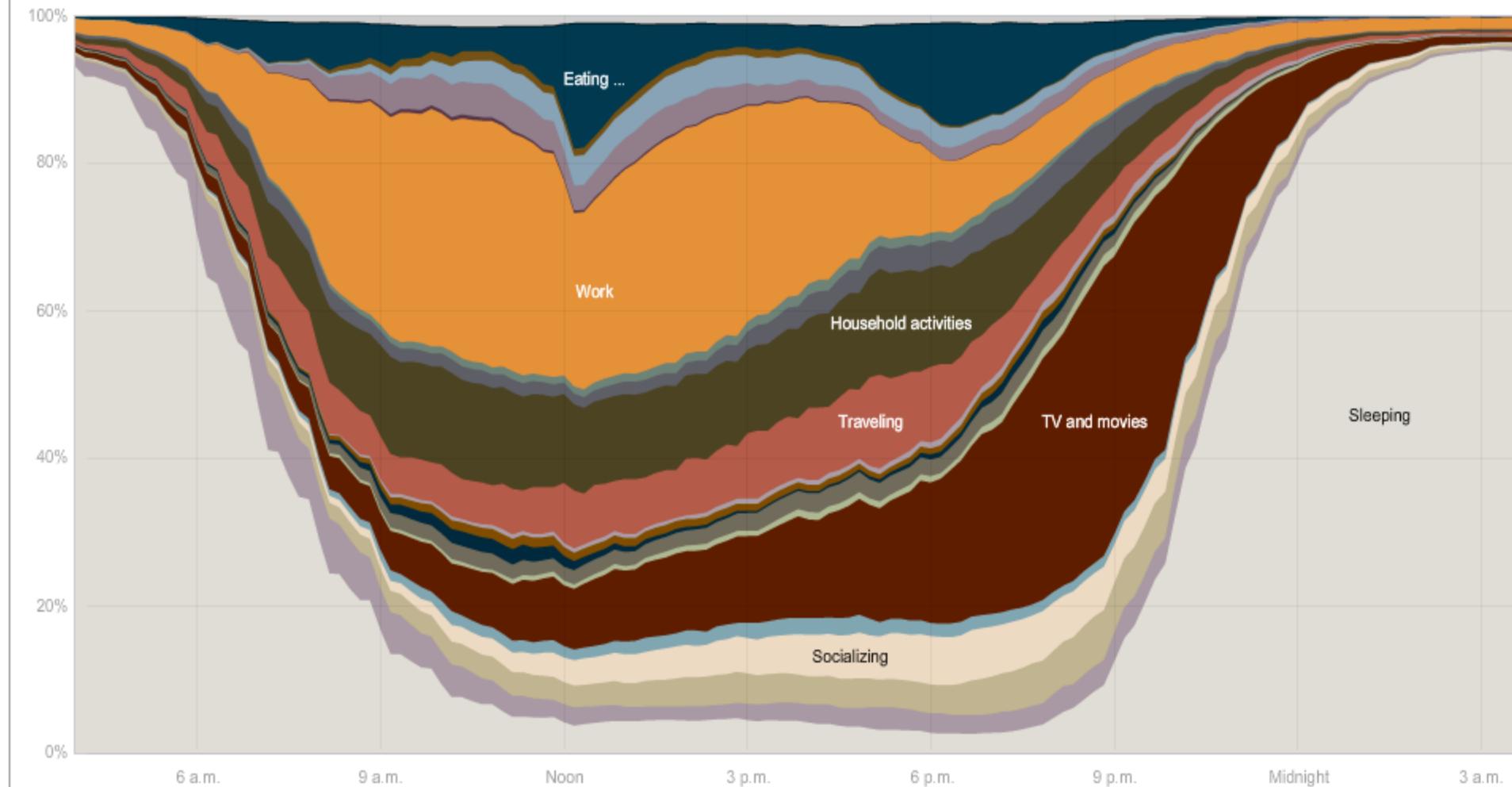
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. [Related article](#)

Everyone

Sleeping, eating, working and watching television take up about two-thirds of the average day.

| Everyone | Employed | White | Age 15-24 | H.S. grads | No children |
|----------|---------------|----------|-----------|------------|---------------|
| Men | Unemployed | Black | Age 25-64 | Bachelor's | One child |
| Women | Not in lab... | Hispanic | Age 65+ | Advanced | Two+ children |



FOCUS + CONTEXT

techniques to show detail (focus) and overview
(context) simultaneously

requires: carefully pick what to show and hinting at
what you are not showing



FOCUS + CONTEXT

synthesis of visual encoding and interaction

user selects region of interest (focus) through
navigation or selection

provide context through aggregation, reduction, or
layering



FOCUS+CONTEXT

④ Embed

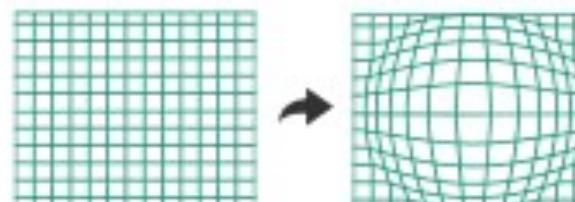
→ Elide Data



→ Superimpose Layer



→ Distort Geometry



④ Embed

→ Elide Data



ELISION

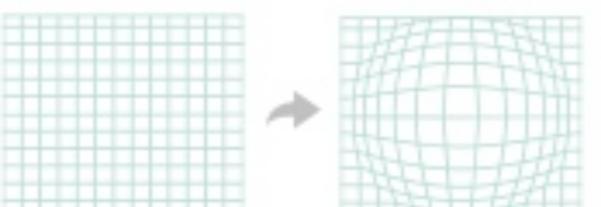
means “suppression”

→ Superimpose Layer



focus items shown in detail,
other items summarized
(suppressed) for context

→ Distort Geometry



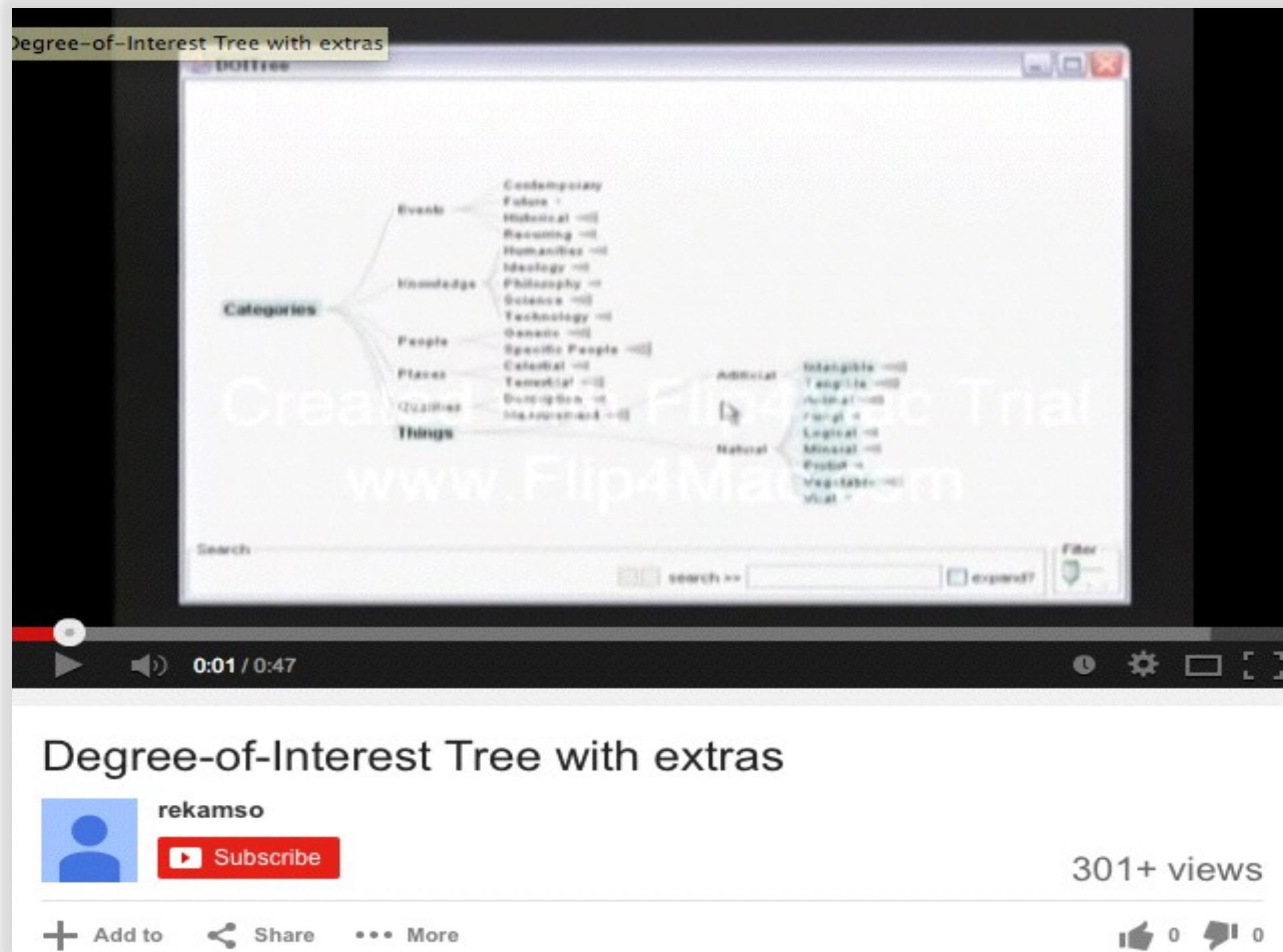
SPACETREE



Grosjean 2002



DOITREE



Heer 2004



DOI

degree of interest

based on observation that humans often represent
their own neighborhood in detail, yet only major
landmarks far away

goal is balance between local detail and global
context



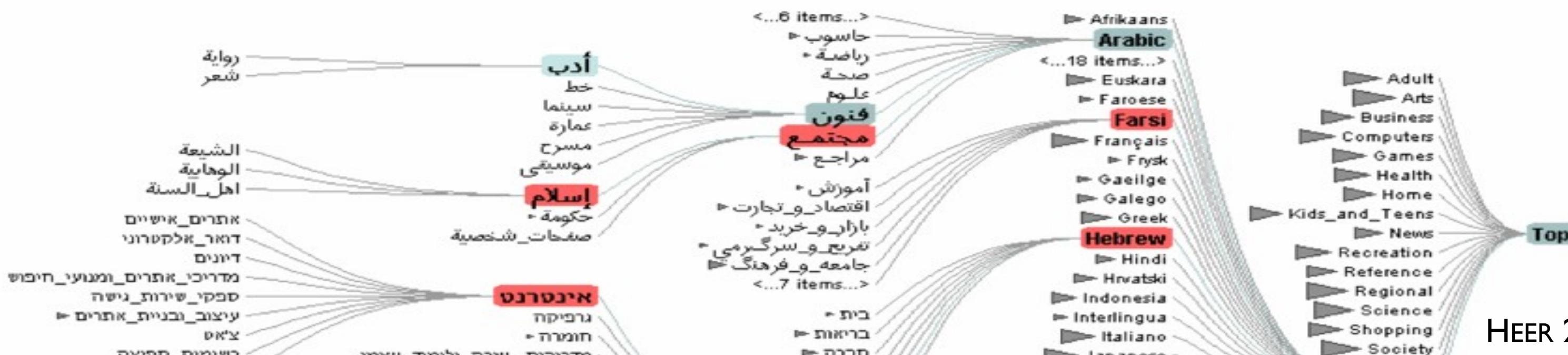
DOITREE

interactive trees with animated transitions that fit within a bounded region of space

layout depends on the user's estimated DOI

use...

logical filtering based on DOI
geometric distortion of node size based on DOI
semantic zooming on content based on node size
aggregate representations of elided subtrees



④ Embed

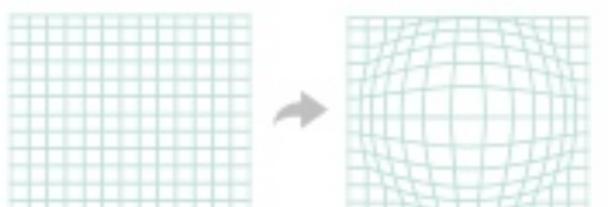
→ Elide Data



→ Superimpose Layer



→ Distort Geometry



SUPERIMPOSE

focus layer limited to a local region of view, instead of stretching across the entire view



TOOLGLASS & MAGIC LENSES

▶ 1:14 / 10:11

CC

L

tablettopresearch201

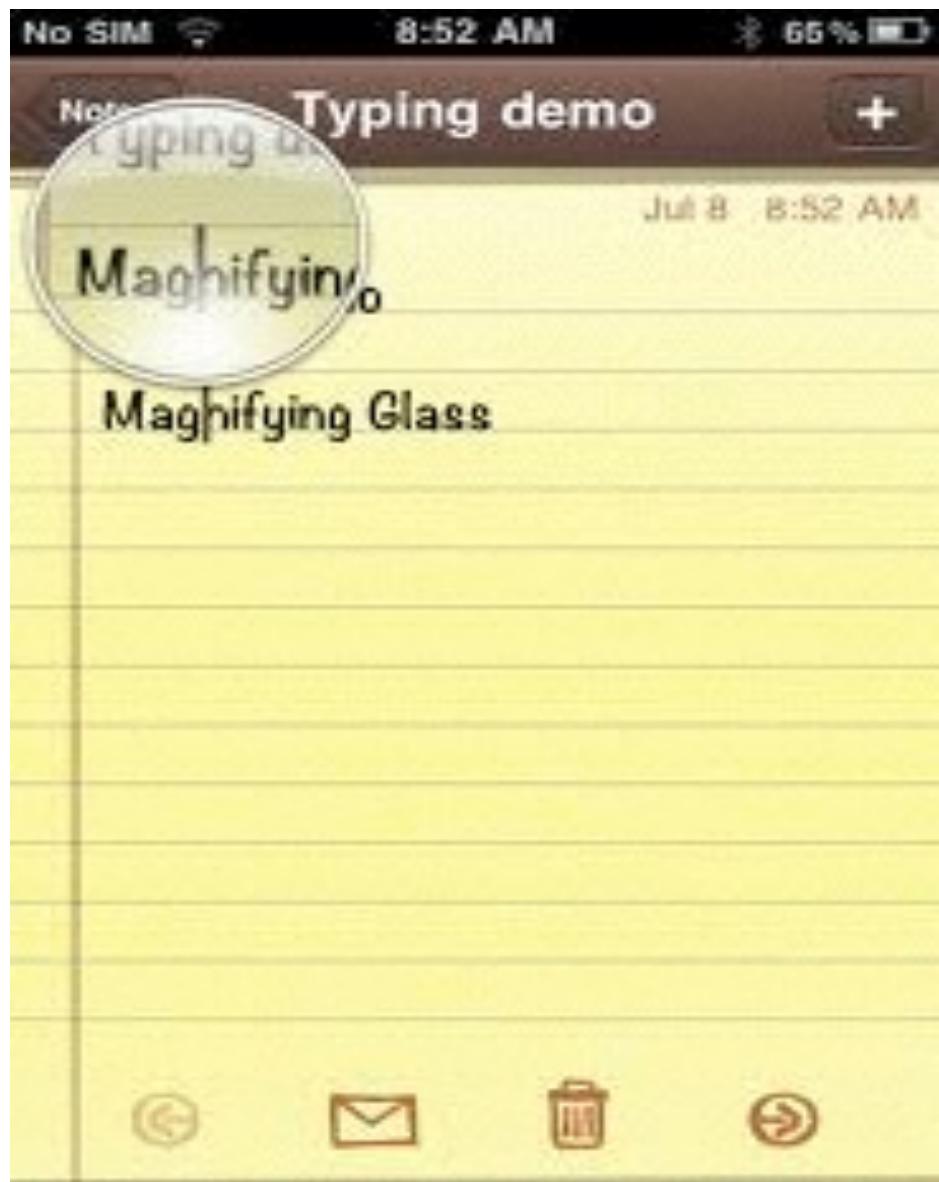
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4,179

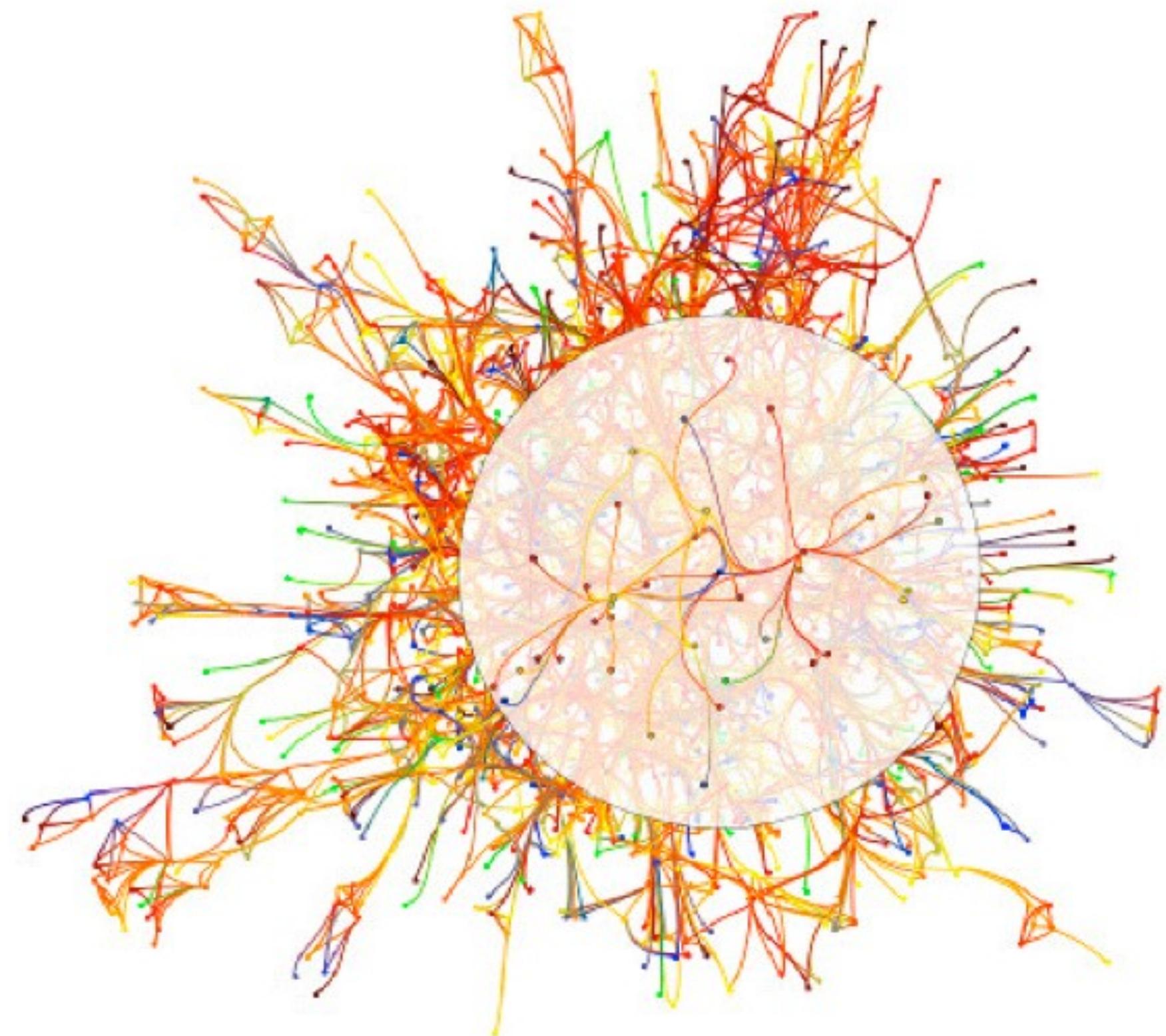
+ Add to Share More

9 0



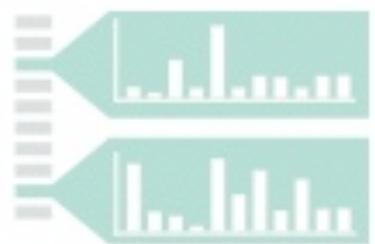


magnification



④ Embed

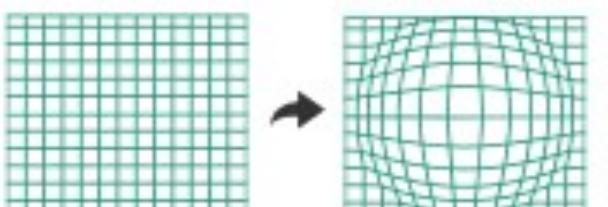
→ Elide Data



→ Superimpose Layer



→ Distort Geometry

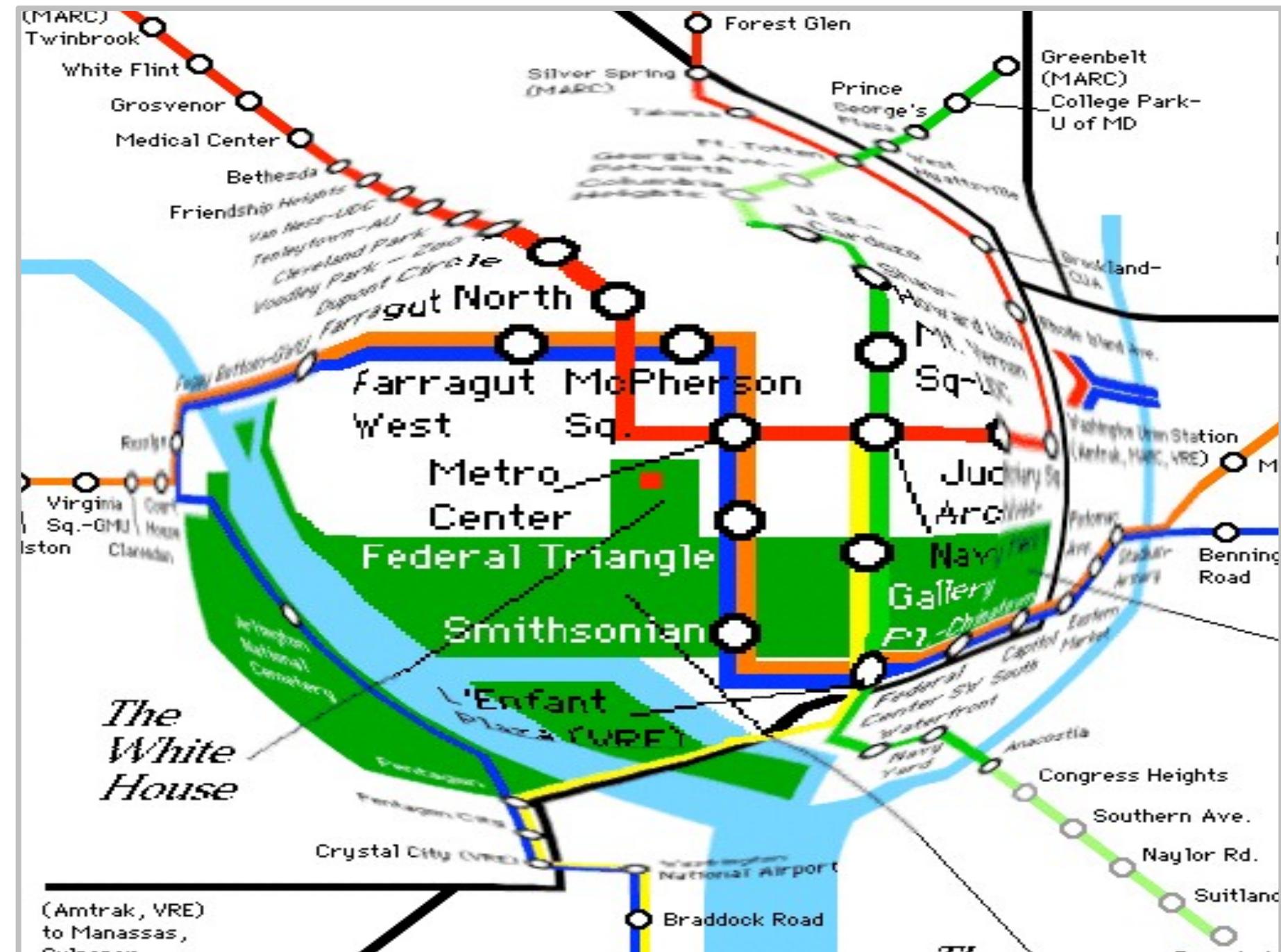


DISTORT

use geometric distortion of
the contextual regions to
make room for the details
in the focus region(s)



FISHEYE





Unfolding - Fisheye and Zoom lens example





Fisheye Tree View



ctominski

[Subscribe](#) 2

100 views

Add to

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More

0 0



HYPERBOLIC GEOMETRY



DISTORTION CONCERNS

unsuitable for relative spatial judgments

overhead of tracking distortion

visual communication of distortion

(use gridlines, shading, etc.)



DISTORTION CONCERNS (CONT.)

target acquisition problem

lens displacing items away from screen location

mixed results compared to separate views and
temporal navigation

fisheye follow-up: concern with enthusiasm over
distortion

what is being shown: selective filtering

how it is being shown: distortion as one possibility



RECOMMENDED READING

Visualization Analysis & Design: Chapter 11 (pp. 242-263), Chapter 12 (pp. 264-297), & Chapter 14 (pp. 322-339)



