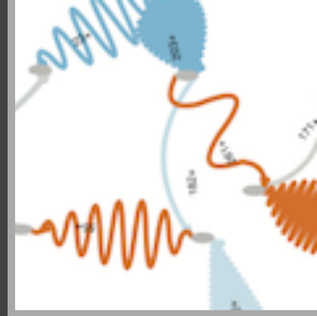
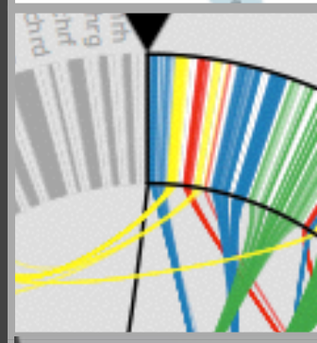
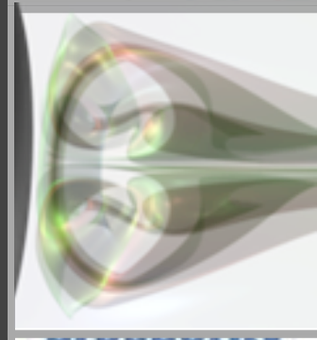
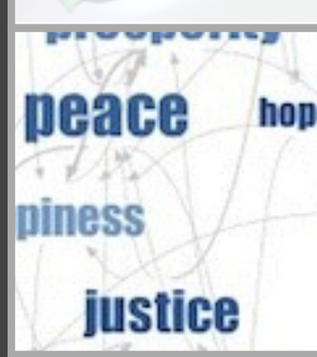
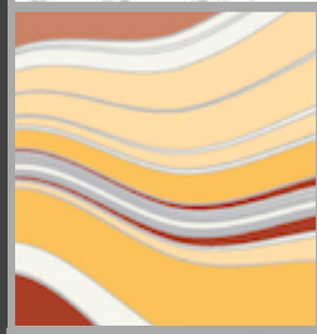
cs6630 | September 25 2014

VIEWS

Miriah Meyer
University of Utah




administrivia . . .

- time-series assignment due on Tuesday

- anyone want to be a note-taker?

last time . . .

task abstraction

Why?

Actions

Analyze

- Consume
  - *Discover*
  - *Present*
  - *Enjoy*
- Produce
  - *Annotate*
  - *Record*
  - *Derive*

Search

	Target known	Target unknown
Location known	*Lookup*	*Browse*
Location unknown	*Locate*	*Explore*

Query

- Identify
- Compare
- Summarize

Targets

All Data

- Trends
- Outliers
- Features

Attributes

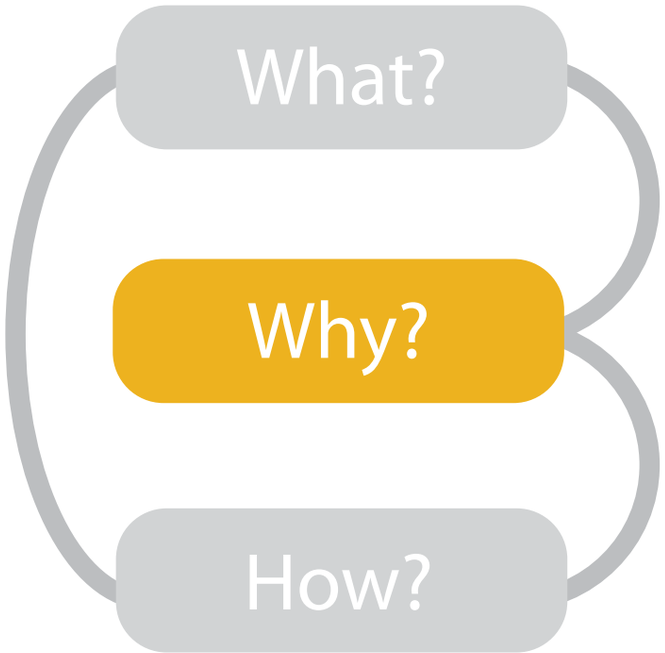
- One
  - *Distribution*
  - *Extremes*
- Many
  - *Dependency*
  - *Correlation*
  - *Similarity*

Network Data

- Topology
- *Paths*

Spatial Data

- Shape



{action, target} pairs

discover distribution
compare trends
locate outliers
browse topology

- **interaction**
  - change over time
  - selection
  - highlighting
  - navigation

GEOMETRIC vs SEMANTIC ZOOMING

today . . .

one vs multiple

`view`: *single layout*

multiple views

eyes over memory

trade-off of display space and working memory

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

Partition into Side-by-Side Views

Superimpose Layers

- view choices
- partitioning
- layering

- view choices
- partitioning
- layering

LINKED VIEWS

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

- **encoding**: same or multiform
- **dataset**: share all, subset, or none
- **highlighting**: to link, or not
- **navigation**: to share, or not

- **encoding**: same or multiform
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MULTIFORM
difference visual encodings are used between the views

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

VisBricks: Multiform Visualization of Large, Inhomogeneous Data - YouTube

http://www.youtube.com/watch?v=_5J80uDTxD8

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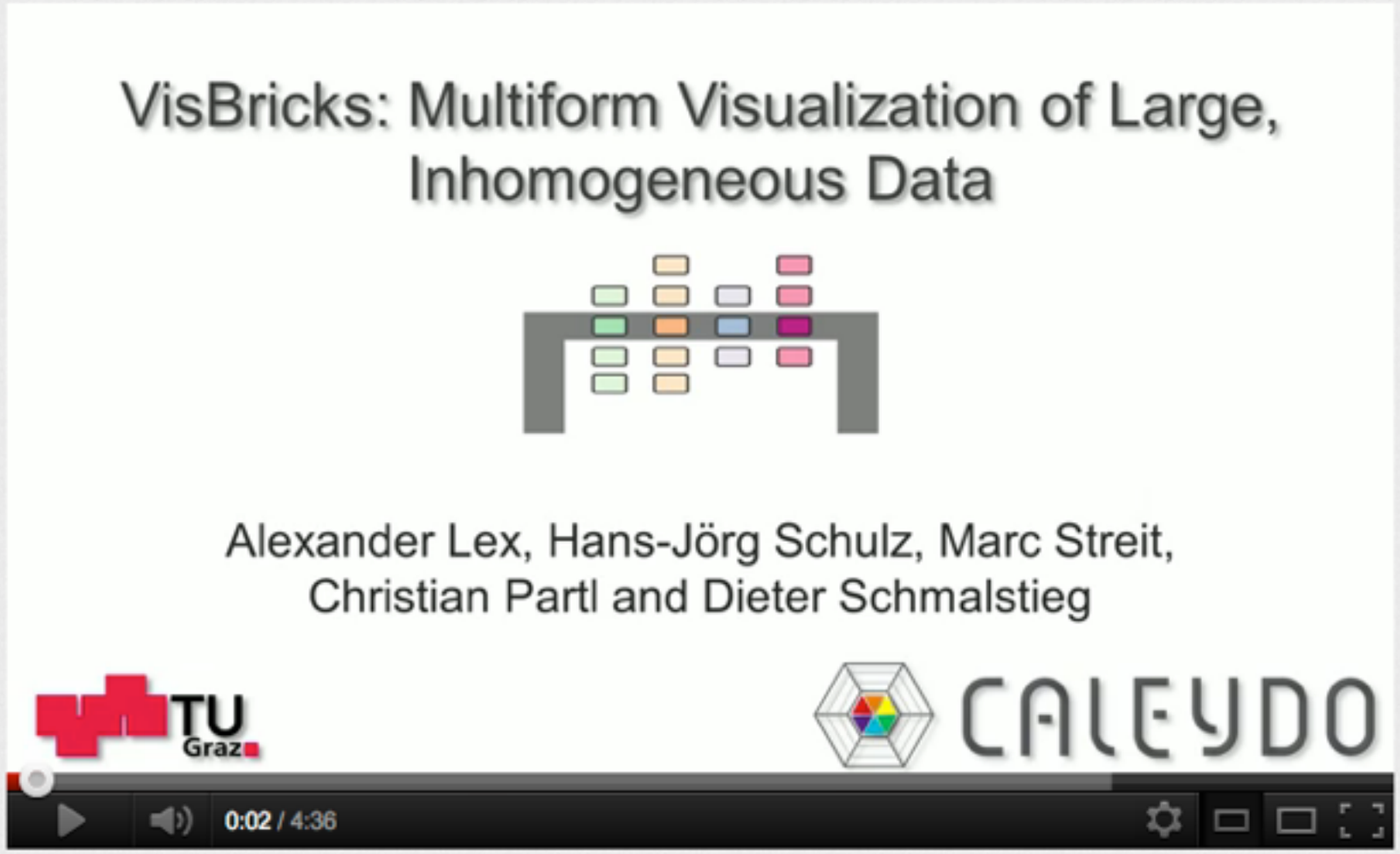
We're changing our privacy policy. This stuff matters. Learn more Dismiss

VisBricks: Multiform Visualization of Large, Inhomogeneous Data

caleydotugraz | Subscribe | 12 videos



Like | + Add to | Share

143 views

1 likes, 0 dislikes

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

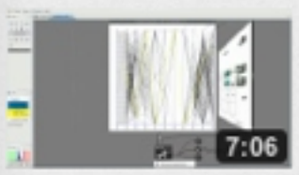
Put Text Into Usable Data
by SASsoftware
5,776 views
Ad

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



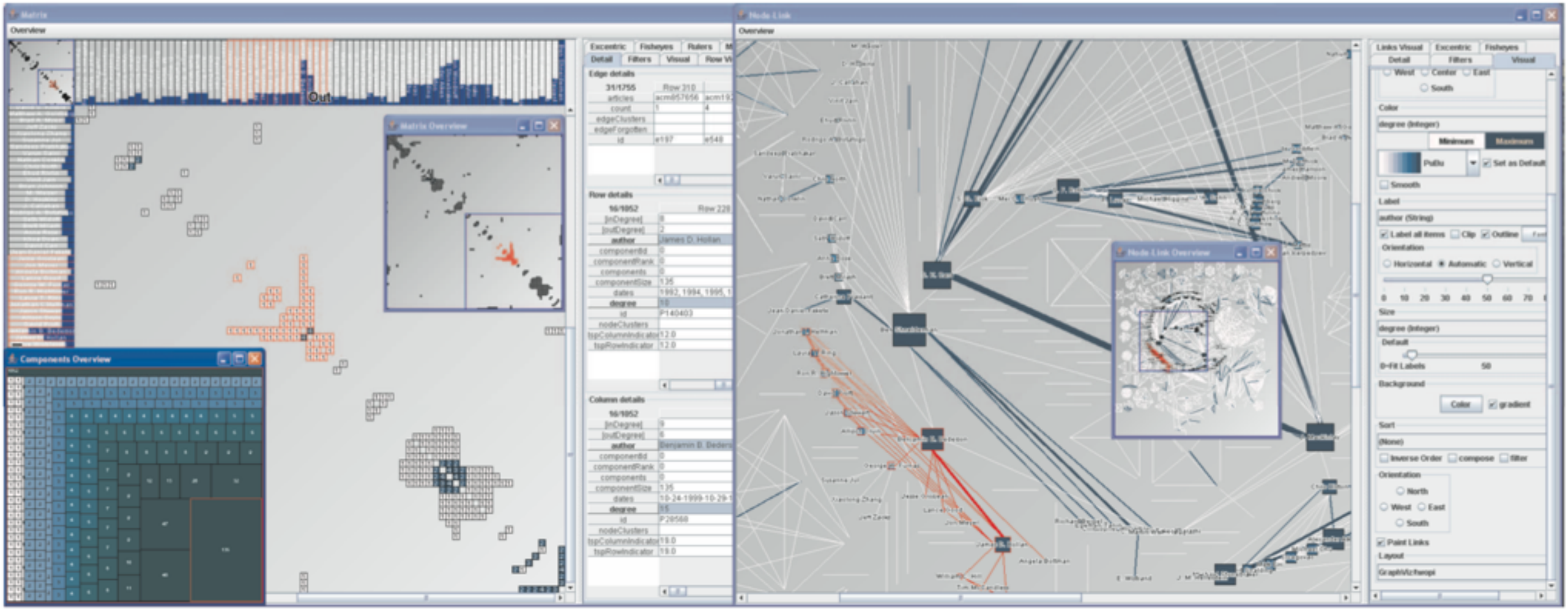
Model-Driven Design for the Visual Analysis of ...
by caleydotugraz
109 views

The Caleydo Jukebox

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

rational
different views support different tasks

MatrixExplorer



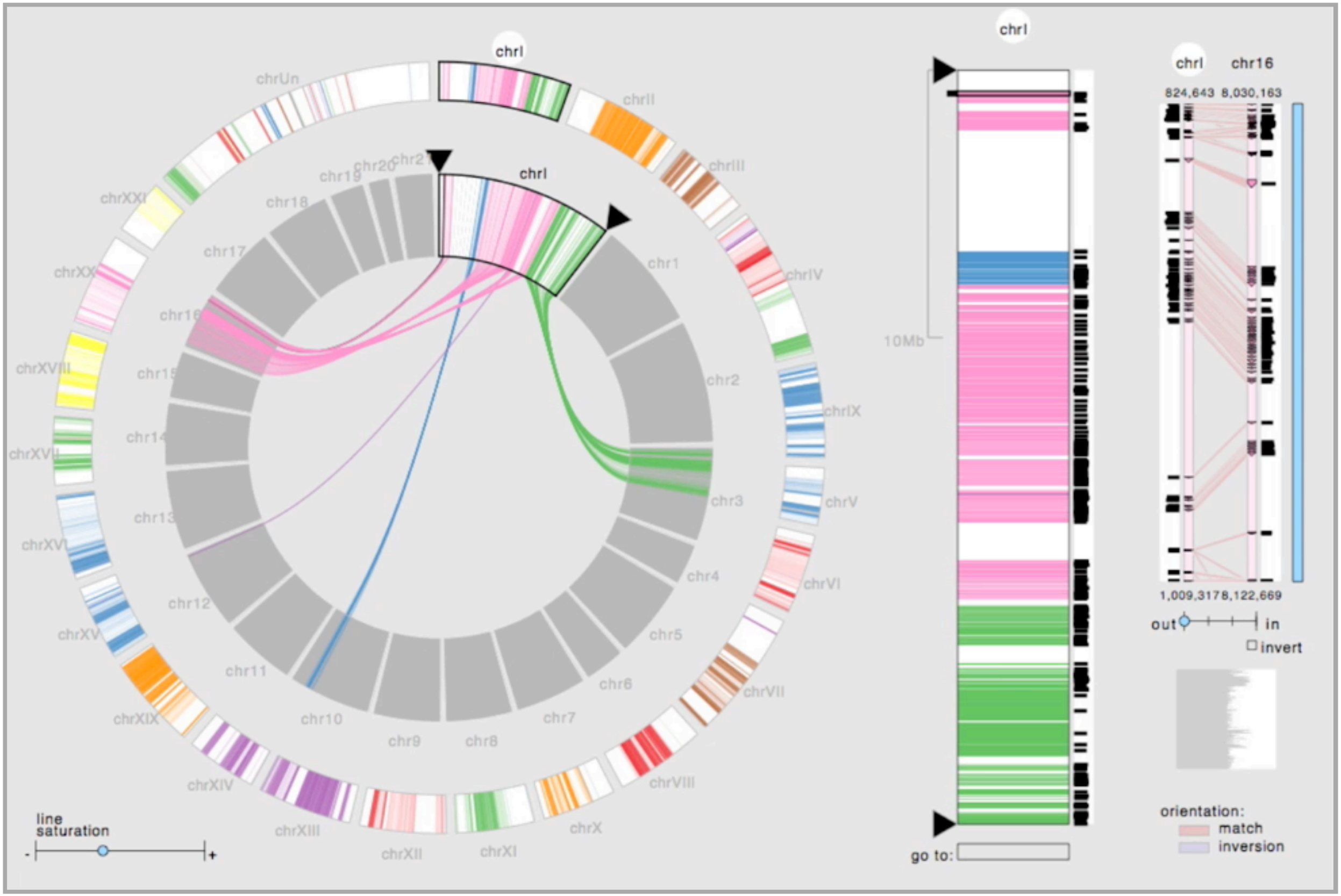
Henry 2006

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


chrI
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824,643
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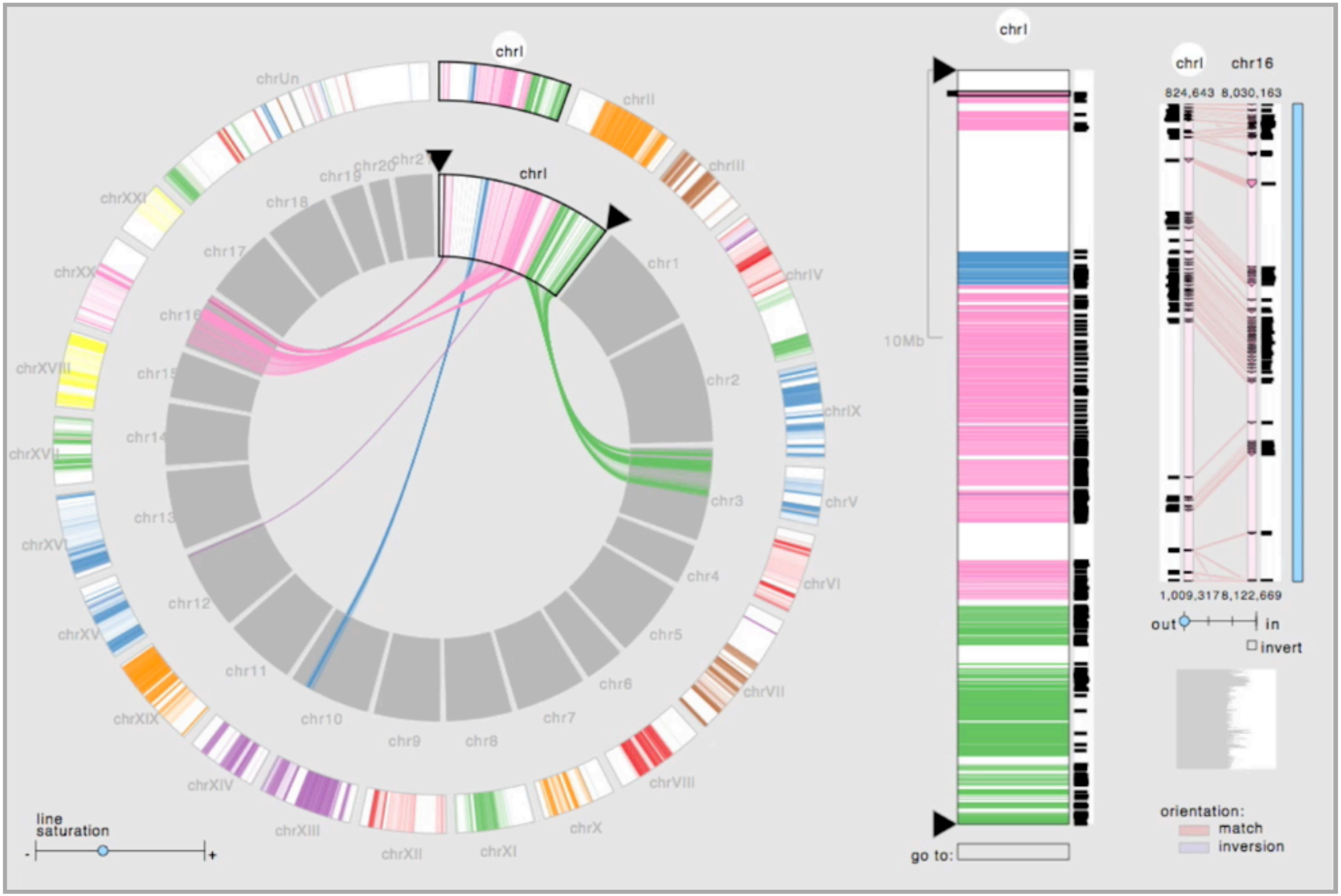
inversion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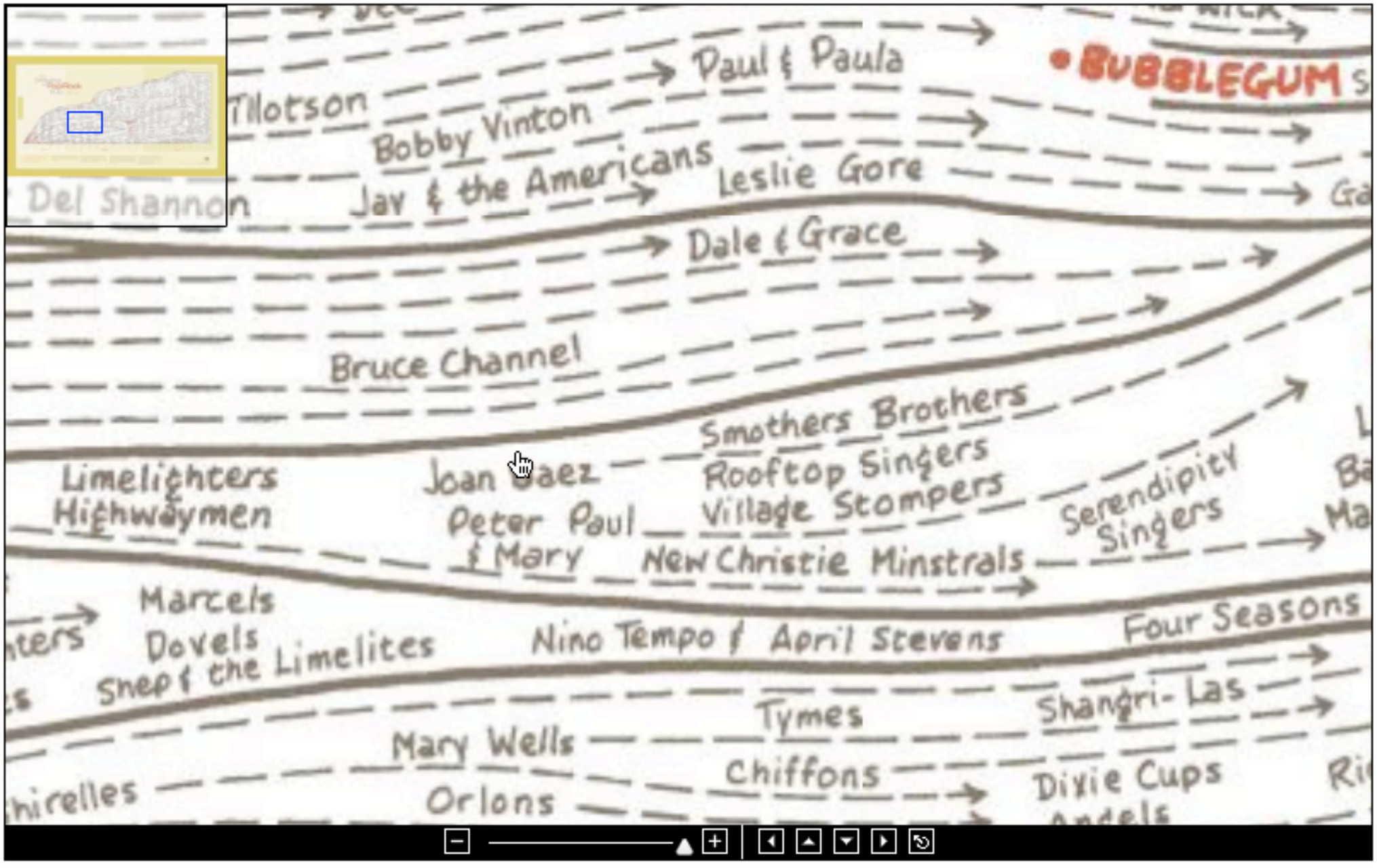
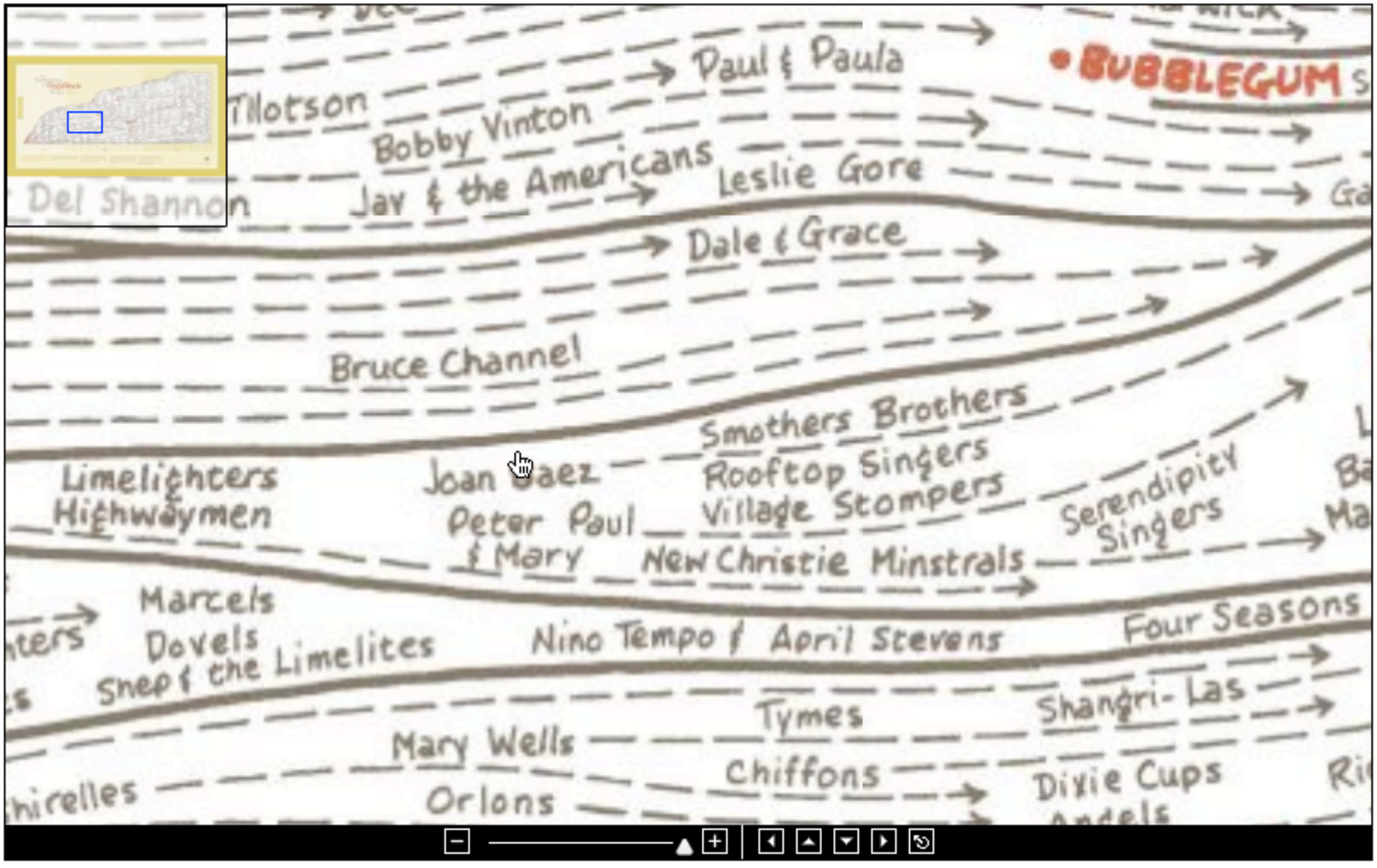

Tillotson
Bobby Vinton
Paul & Paula
BUBBLEGUM
Del Shannon
Jay & the Americans
Leslie Gore
Dale & Grace
Bruce Channel
Limelighters
Highwaymen
Joan Baez
Smothers Brothers
Rooftop Singers
Village Stompers
Peter Paul & Mary
New Christie Minstrals
Serendipity Singers
Marcels
Dovells
Shep & the Limelites
Nino Tempo & April Stevens
Four Seasons
Mary Wells
Tymes
Shangri-Las
Chiffons
Orlons
Dixie Cups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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

File Edit View Select Layout Plugins Help

Cerebral_loc Search:

CytoPanel 1

Network | Cerebral | Editor

Edge curviness

Straight Bundled

Label density

Dense Sparse

Group label size

Off Small Large

Show function clusters

Show layer separators

High quality rendering

Relayout

Expression color scale

-5 -1.5 1.5 5

Comparison color scale

-2 0 2

Significance cut-off

1 0.1 0.01 0.001 1

Expression cutoff

±0 ±1 ±2 ±3 ±4 0

Expression data are ratios

Groups

Add group Delete group

vid_net_basic.sif

LPS_1

LPSLL37_1

TIRAP CHUK BTK IRAK1 NFKBIB

TICAM1 MAPK1 MYD88 NFKBIA IKBKB MAP2K4

IRF7 STAT1 MAPK13 MAPK8IP3

C2 IRF3 NFKB1 ELK1

EP300 ATF2 SRF

Transcription factor

FOS

Chemokine

CX3CL1 CCL3 CXCL5

Receptor

TNFRSF6 CCR7

APOE ACTB

Structural

Extracellular matrix

Transcription regulation

Cytoskeleton

Cytopl

Nucleu

Transc Regula Genes

CytoPanel 2

2 -2

LPS_1 LPSLL37_1 LPS_2 LPSLL37_2 LPS_4 LPSLL37_4 LPS_24 LPSLL37_24

11 8 6 5 4 4 4 3 3

9 8 6 4 4 4 4 3 1

0 10 20 30 40 50

Node Attribute Browser | Edge Attribute Browser | Network Attribute Browser | Parallel Coordinates

Welcome to Cytoscape 2.4.1 Right-click + drag to ZOOM Middle-click + drag to PAN

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Node Attribute Browser | Edge Attribute Browser | Network Attribute Browser | Parallel Coordinates

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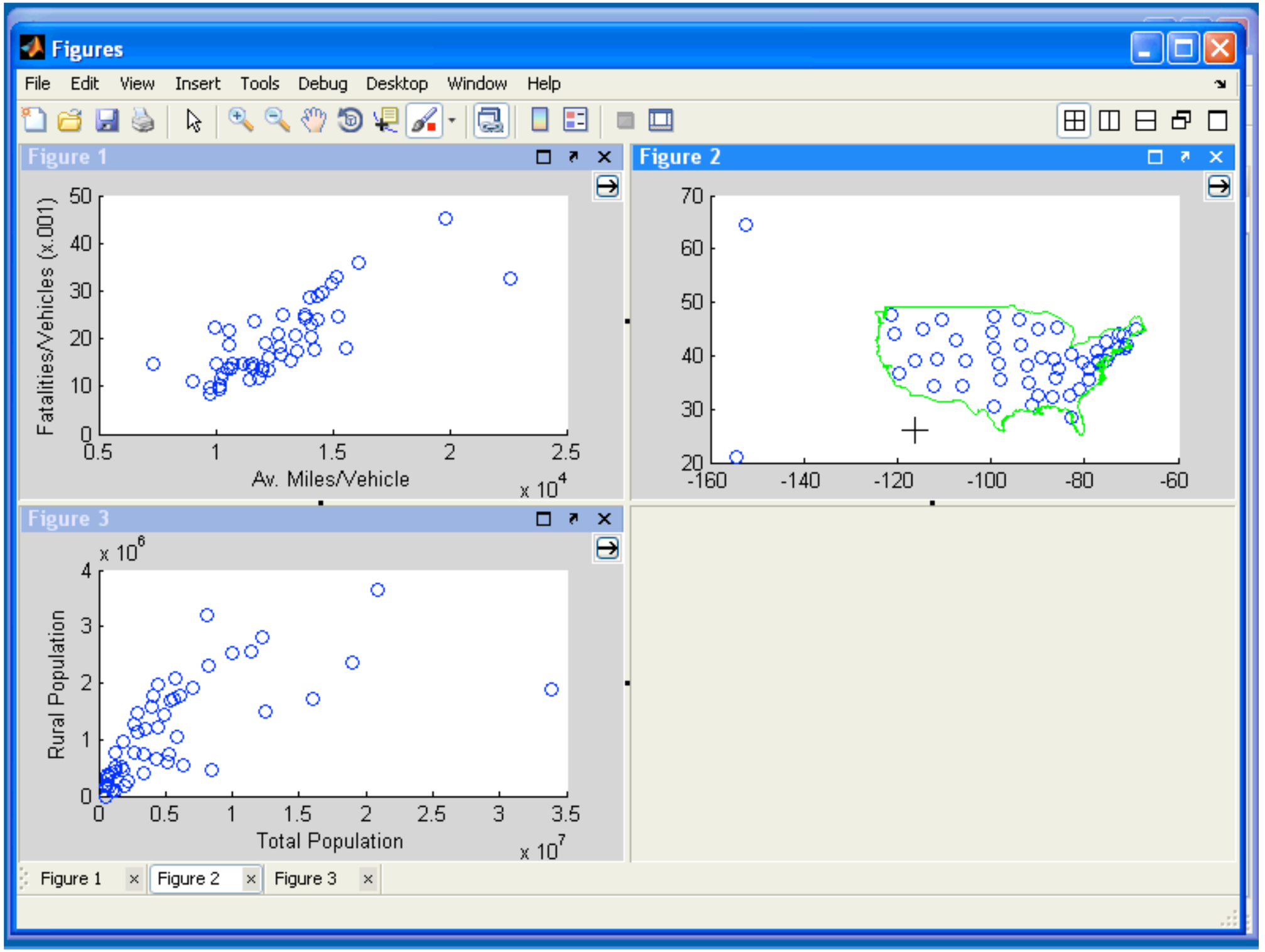
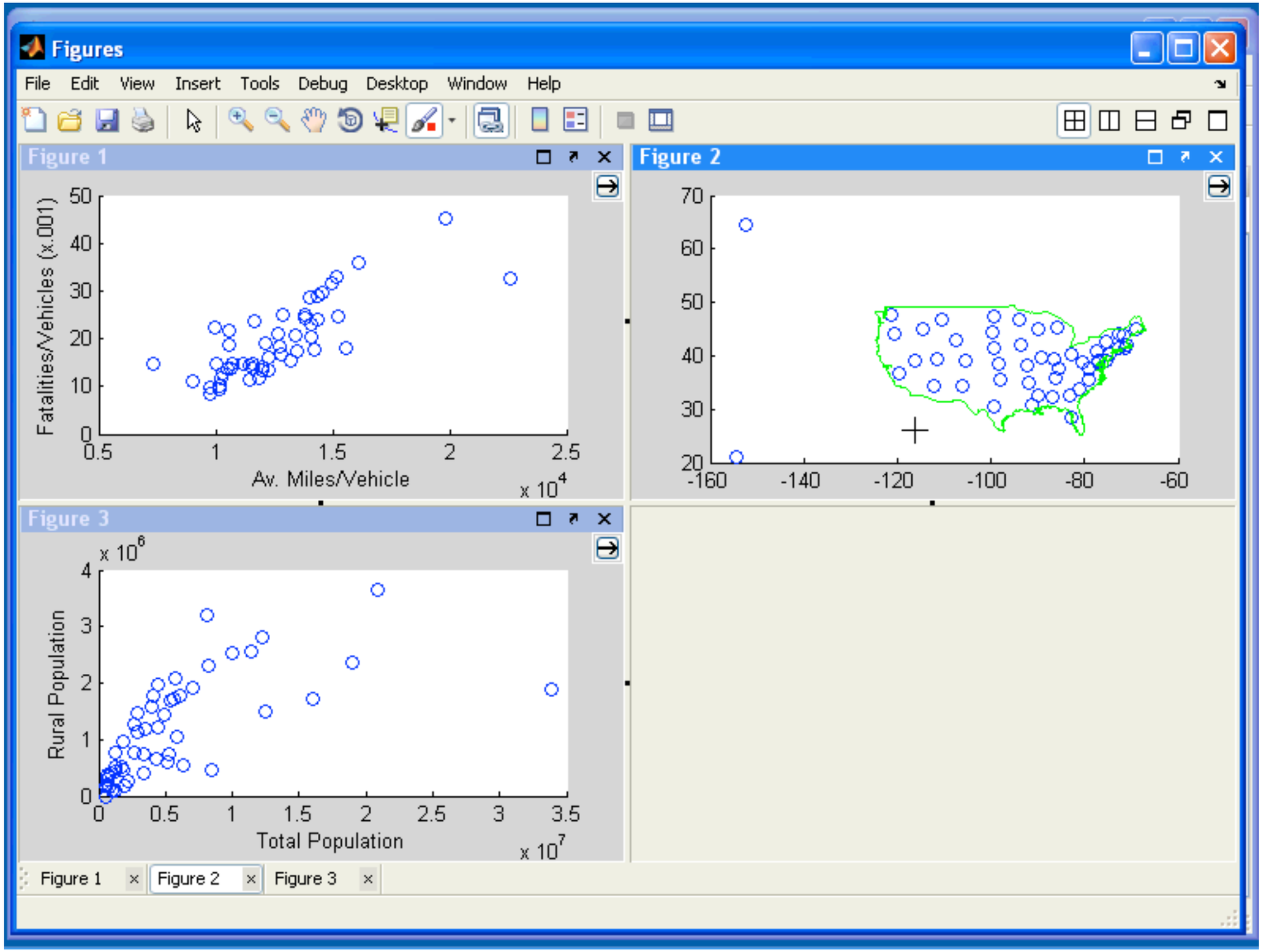
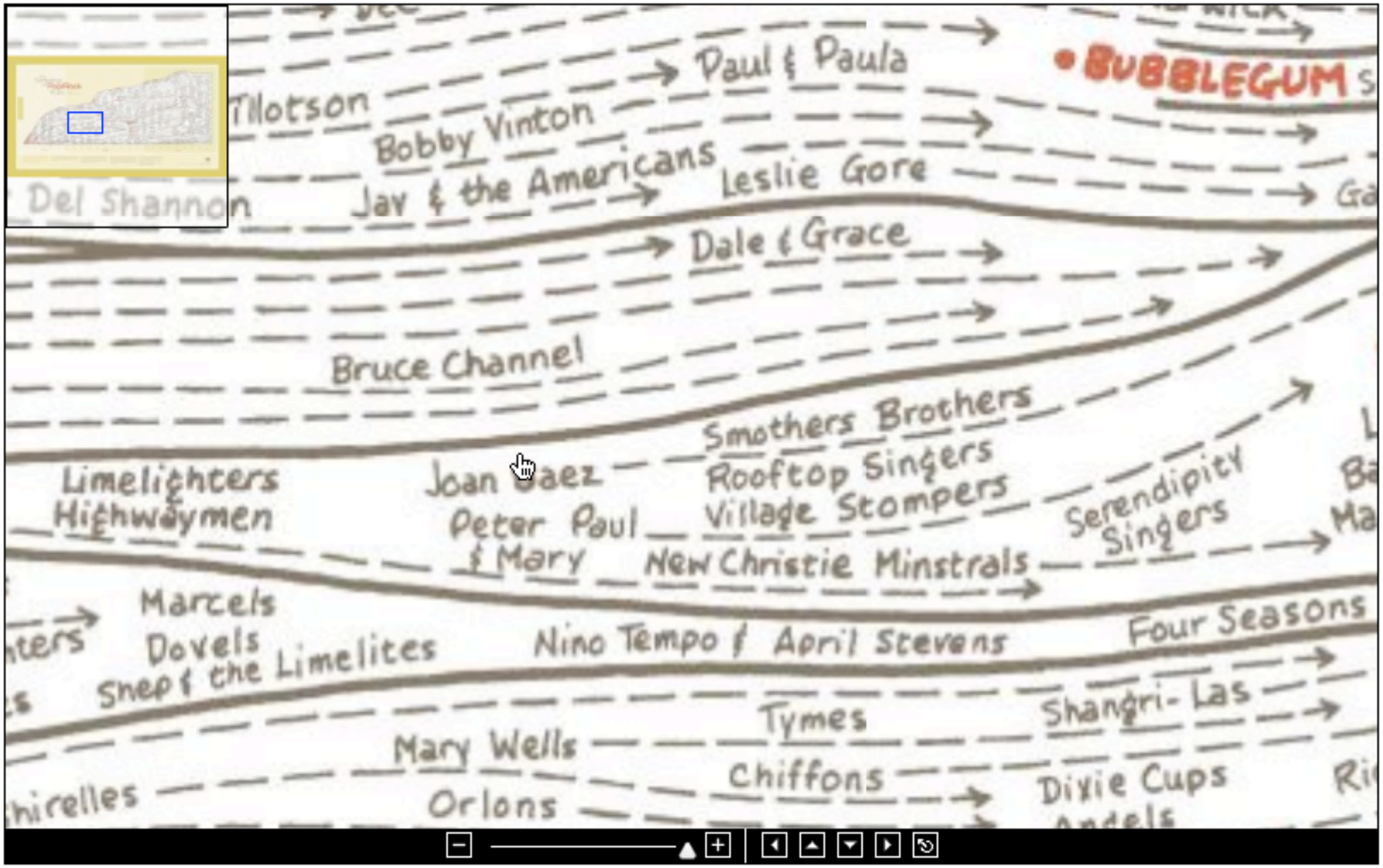
LINKED HIGHLIGHTING



LINKED HIGHLIGHTING

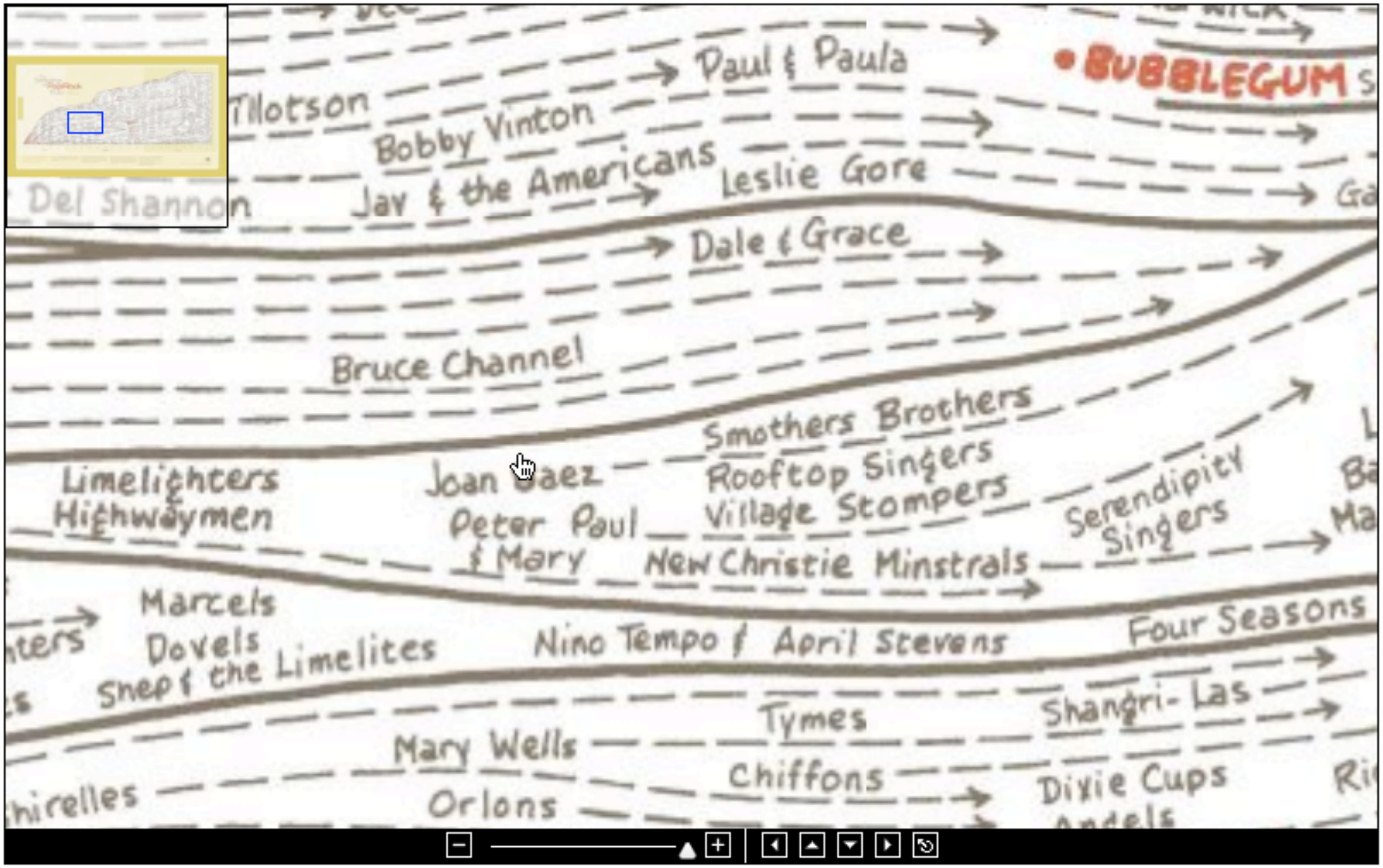


LINKED NAVIGATION



http://www.historyshots.com/rockmusic/

LINKED NAVIGATION



http://www.historyshots.com/rockmusic/

- view choices
- partitioning
- layering

PARTITIONING

action on the dataset that separates the data into groups

design choices

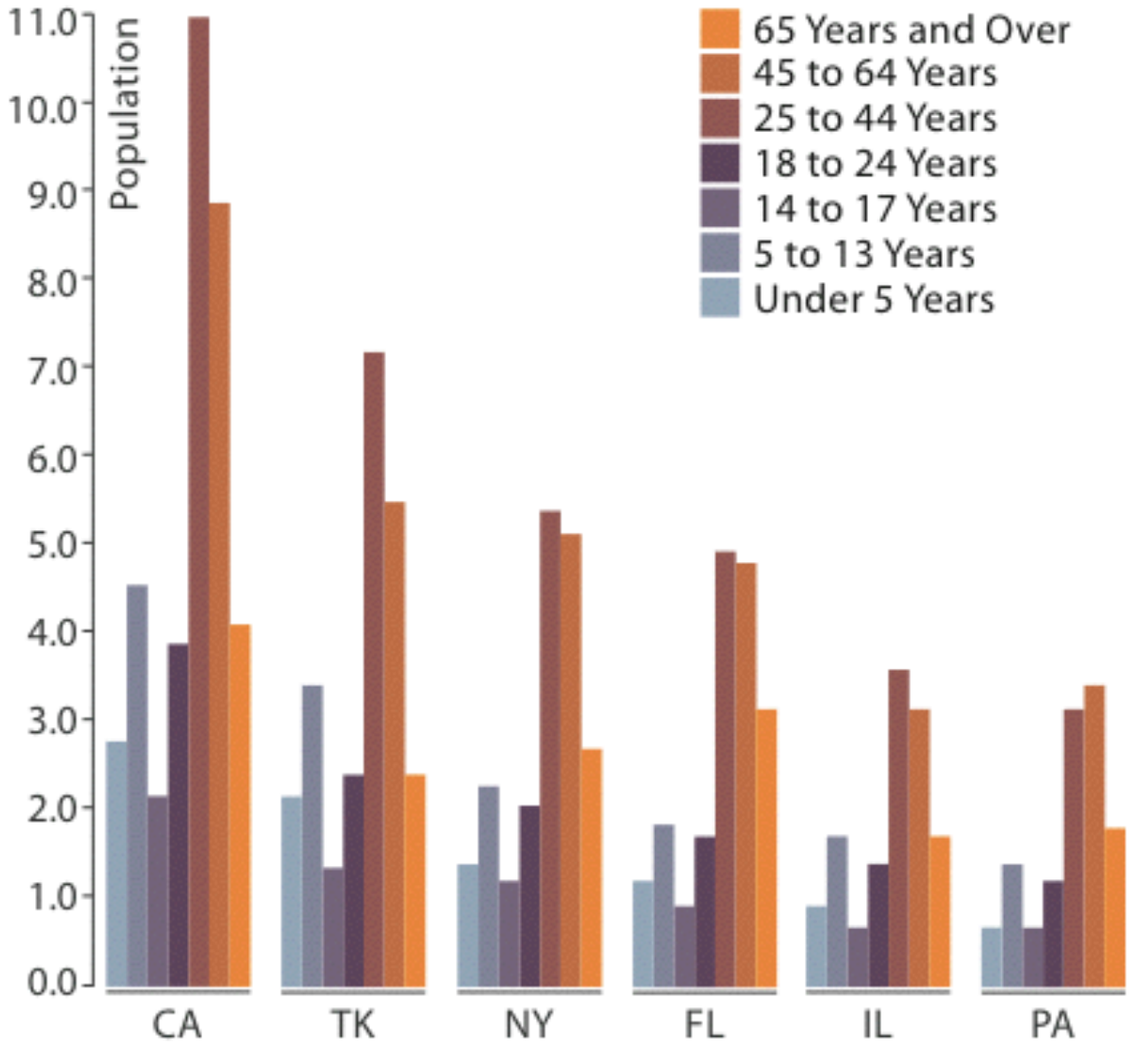
how to divide data up between views, given a hierarchy of attributes

how many splits, and order of splits

how many views (usually data driven)

partition attribute(s)

typically categorical


Population
11.0
10.0
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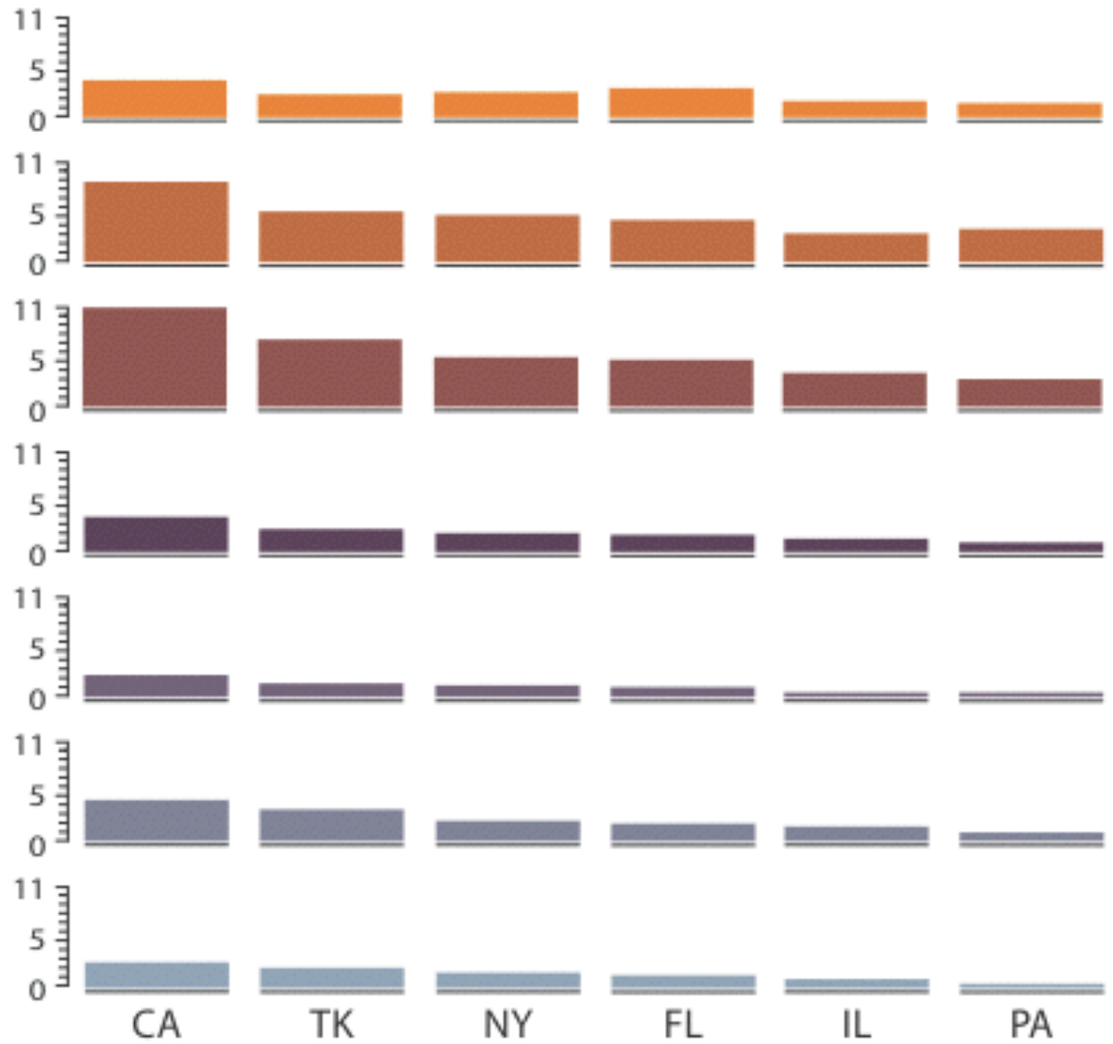
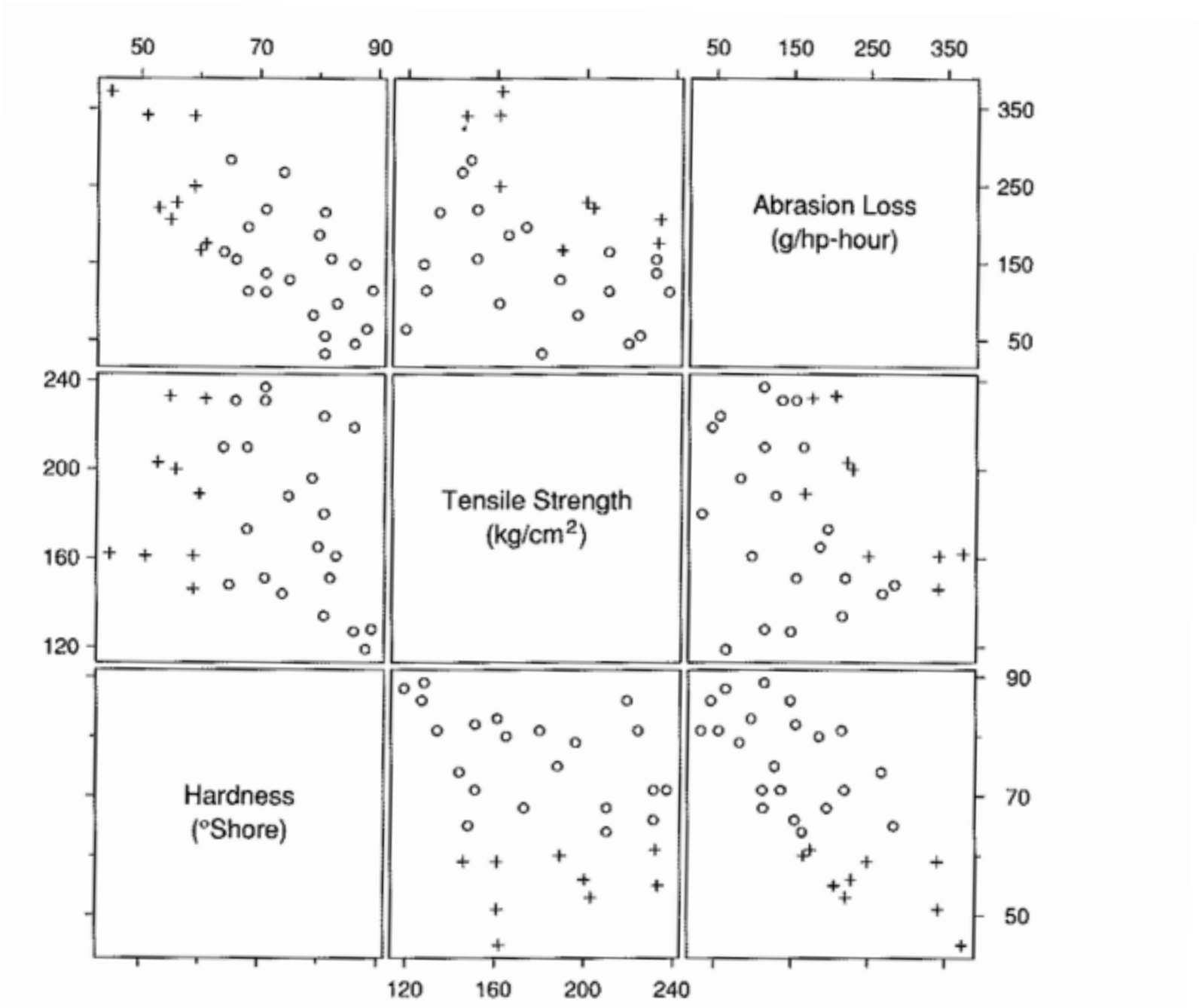
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
65 Years and Over
45 to 64 Years
25 to 44 Years
18 to 24 Years
14 to 17 Years
5 to 13 Years
Under 5 Years
CA
TK
NY
FL
IL
PA


11
5
0
CA
TK
NY
FL
IL
PA

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.

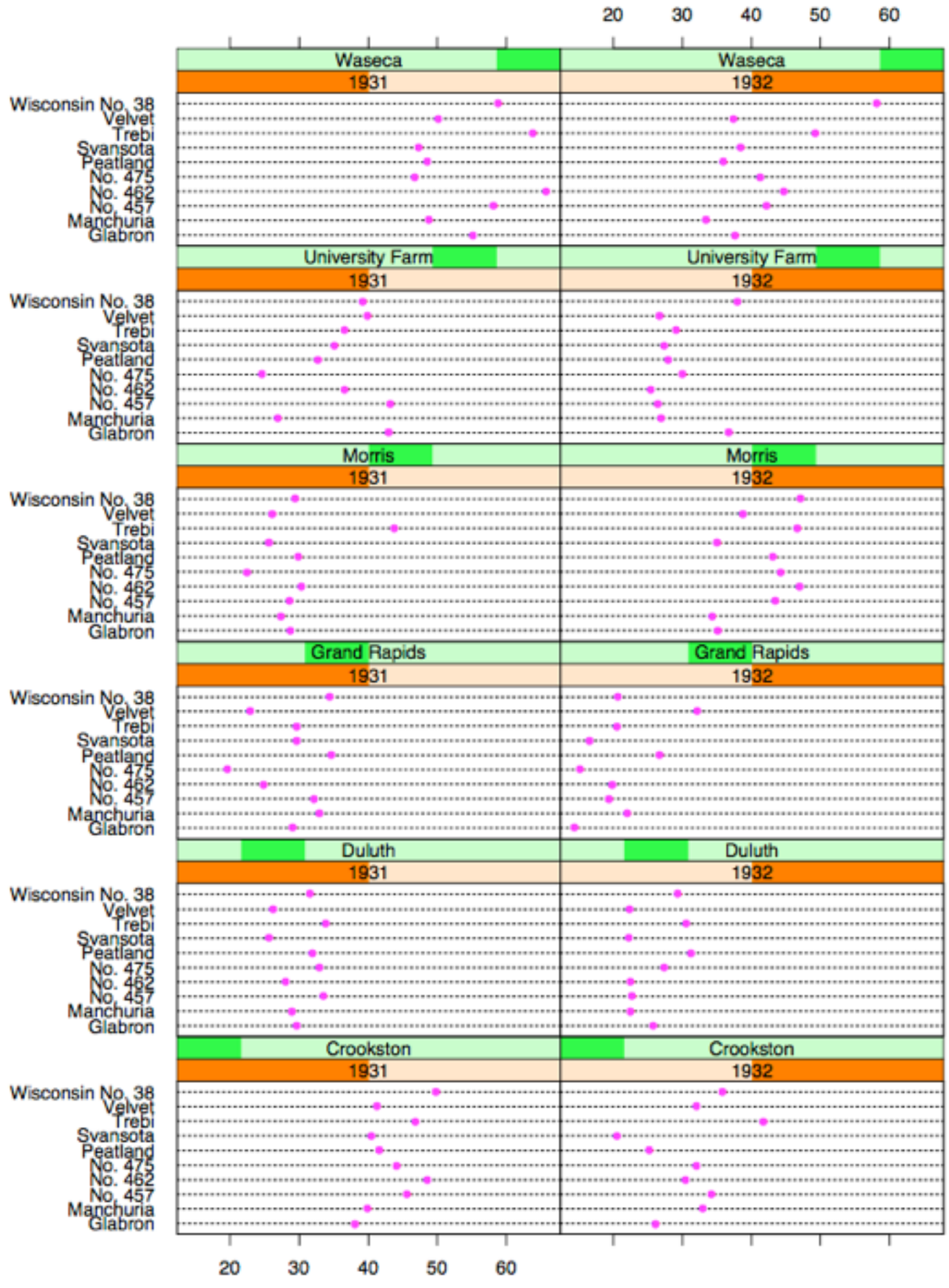
Cleveland 1994

TRELLIS

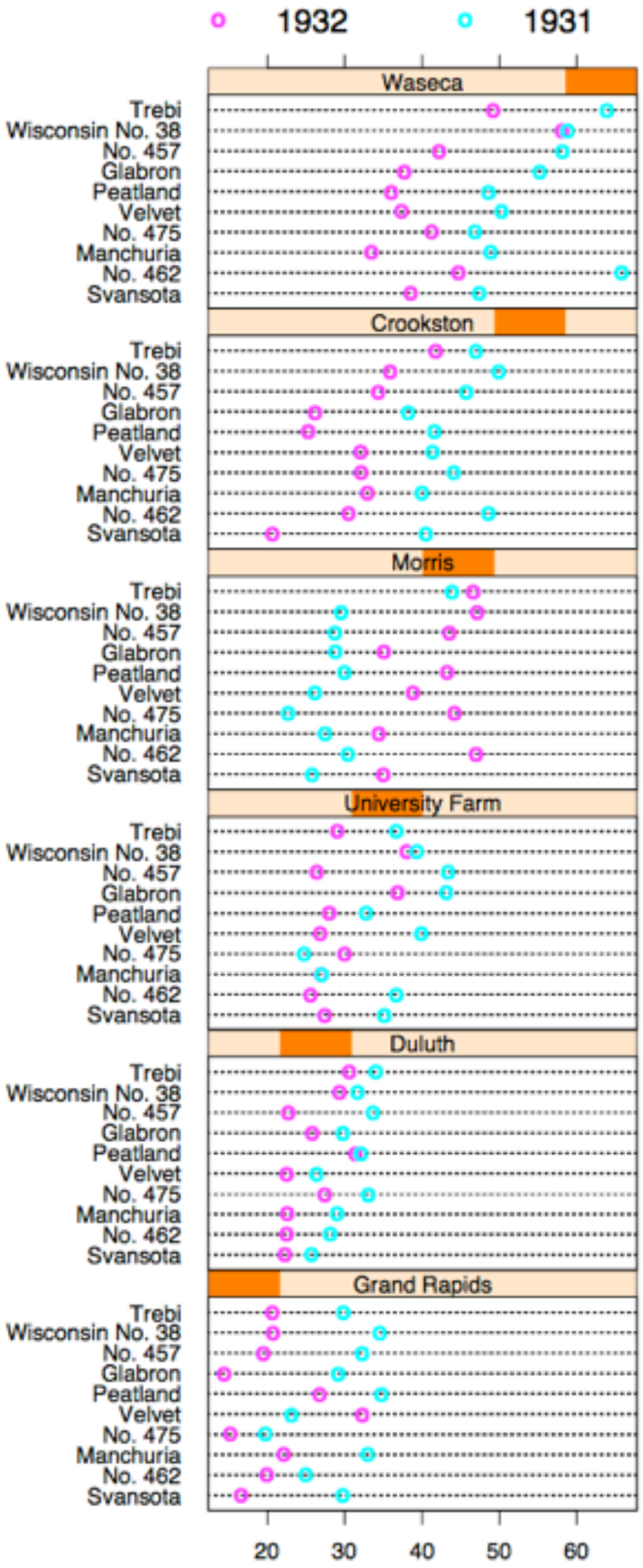
- **panel variables**
  - attributes encoded in individual views
- **partitioning variables**
  - partitioning attributes assigned to columns, rows, and pages
- **main-effects ordering**
  - order partitioning variable levels/states based on derived data
  - support perception of trends and structure in data

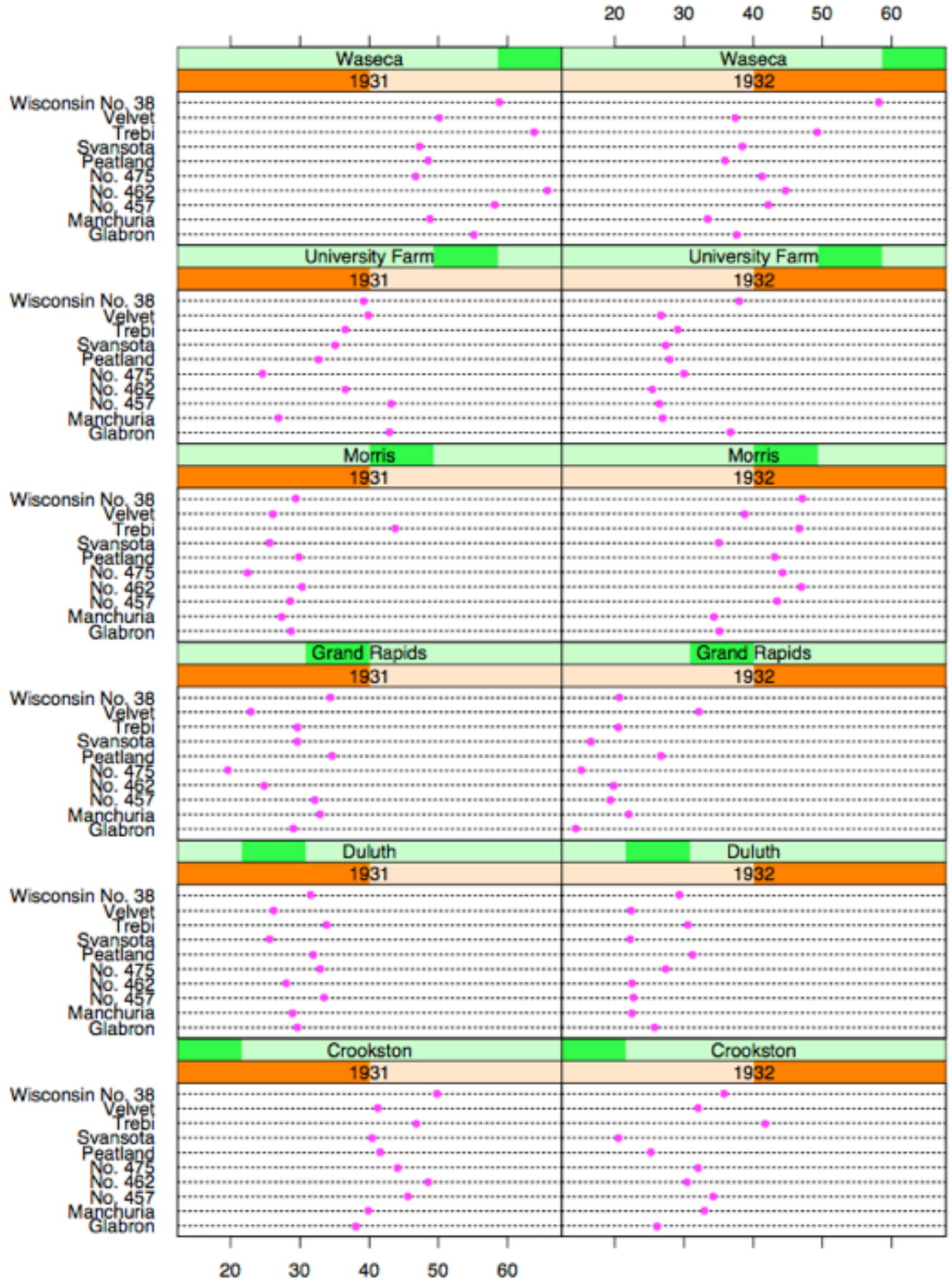
Becker 1996

sort by group medians



Becker 1996


1932
1931
Waseca
Trebi
Wisconsin No. 38
No. 457
Glabron
Peatland
Velvet
No. 475
Manchuria
No. 462
Svansota
Crookston
Morris
University Farm
Duluth
Grand Rapids
20
30
40
50
60
Barley Yield (bushels/acre)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60
Waseca
1931
1932
University Farm
Morris
Grand Rapids
Duluth
Crookston
Wisconsin No. 38
Velvet
Trebi
Svansota
Peatland
No. 475
No. 462
No. 457
Manchuria
Glabron
Barley Yield (bushels/acre)

Becker 1996

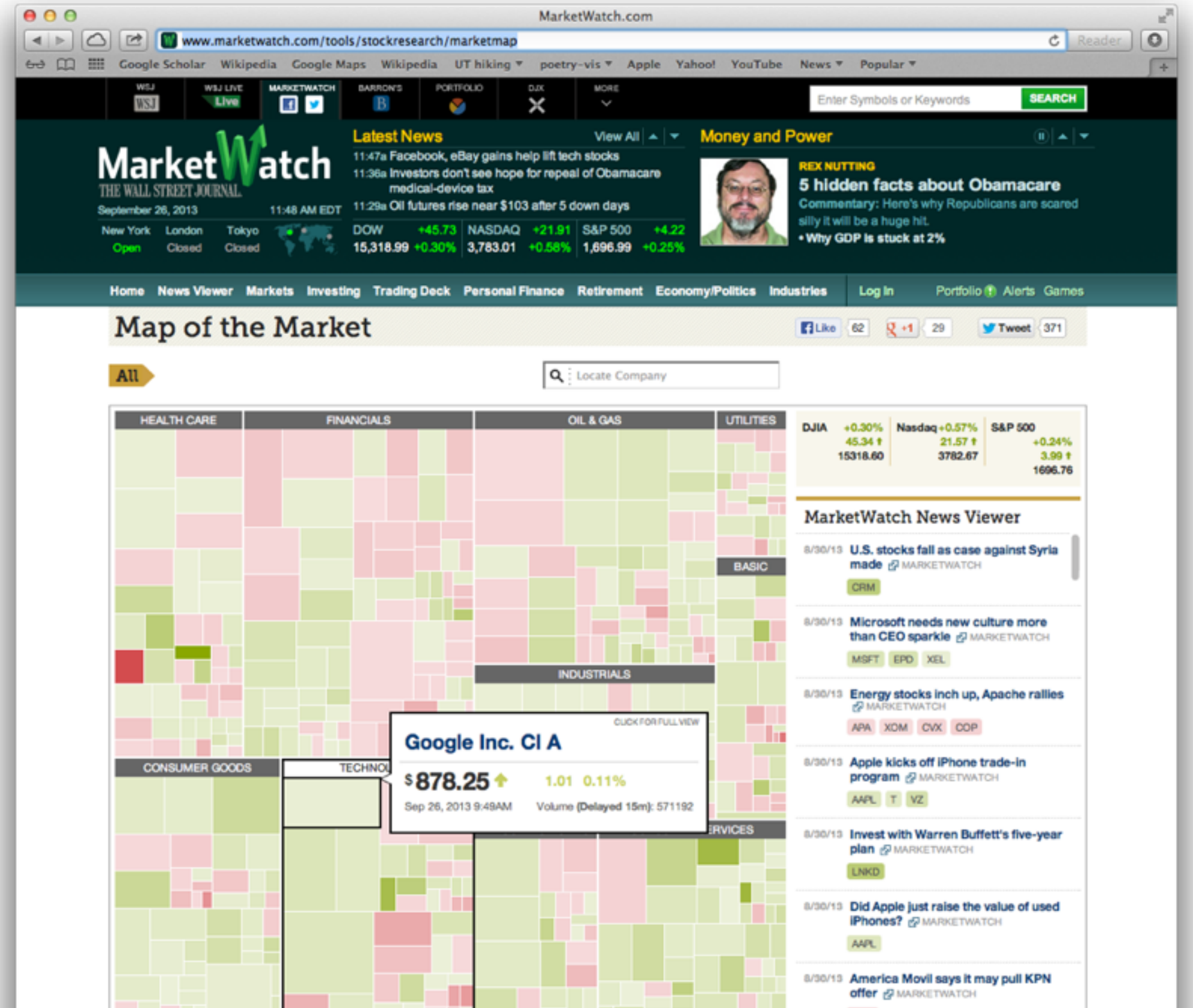
HiVE

Hierarchical Visual Expression

- **partitioning:** transform data attributes into a hierarchy
- reconfigure partitioning hierarchies to explore data space
- use **treemaps** as spacefilling rectangular layouts

Slingsby 2009

TREEMAP


MarketWatch.com
www.marketwatch.com/tools/stockresearch/marketmap
Reader
Google Scholar Wikipedia Google Maps Wikipedia UT hiking poetry-vis Apple Yahoo! YouTube News Popular
WSJ WSJ LIVE MARKETWATCH BARRON'S PORTFOLIO DJX MORE
Enter Symbols or Keywords SEARCH
MarketWatch
THE WALL STREET JOURNAL.
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11:47a Facebook, eBay gains help lift tech stocks
11:36a Investors don't see hope for repeal of Obamacare medical-device tax
11:29a Oil futures rise near $103 after 5 down days
DOW +45.73 15,318.99 +0.30%
NASDAQ +21.91 3,783.01 +0.58%
S&P 500 +4.22 1,696.99 +0.25%
Money and Power
REX NUTTING
5 hidden facts about Obamacare
Commentary: Here's why Republicans are scared silly it will be a huge hit.
• Why GDP is stuck at 2%
Home News Viewer Markets Investing Trading Deck Personal Finance Retirement Economy/Politics Industries
Log In Portfolio Alerts Games
Map of the Market
Like 62 +1 29 Tweet 371
All
Locate Company
HEALTH CARE
FINANCIALS
OIL & GAS
UTILITIES
BASIC
INDUSTRIALS
CONSUMER GOODS
CLICK FOR FULL VIEW
Google Inc. Cl A
$878.25 1.01 0.11%
Sep 26, 2013 9:49AM Volume (Delayed 15m): 571192
DJIA +0.30% 45.34 15318.60
Nasdaq +0.57% 21.57 3782.67
S&P 500 +0.24% 3.99 1696.76
MarketWatch News Viewer
8/30/13 U.S. stocks fall as case against Syria made MARKETWATCH CRM
8/30/13 Microsoft needs new culture more than CEO sparkle MARKETWATCH MSFT EPD XEL
8/30/13 Energy stocks inch up, Apache rallies MARKETWATCH APA XOM CVX COP
8/30/13 Apple kicks off iPhone trade-in program MARKETWATCH AAPL T VZ
8/30/13 Invest with Warren Buffett's five-year plan MARKETWATCH LNKD
8/30/13 Did Apple just raise the value of used iPhones? MARKETWATCH AAPL
8/30/13 America Movil says it may pull KPN offer MARKETWATCH

HiVE

Hierarchical Visual Expression

- **partitioning:** transform multidimensional data into a hierarchy
- reconfigure partitioning hierarchies to explore data space
- **use treemaps as spacefilling rectangular layouts**
  - each rectangle is a partitioned subset
  - nested graphical summaries
    - *size, shape, color used to show subset properties*
    - *containment ordering by partition variables*

Slingsby 2009

HiVE example: London property

partitioning attributes

house type
neighborhood
sale time

encoding attributes

average price (color)
number of sales (size)

results

between neighborhoods, different housing distributions

within neighborhoods, similar prices

Slingsby 2009

HiVE example: London property

partitioning attributes

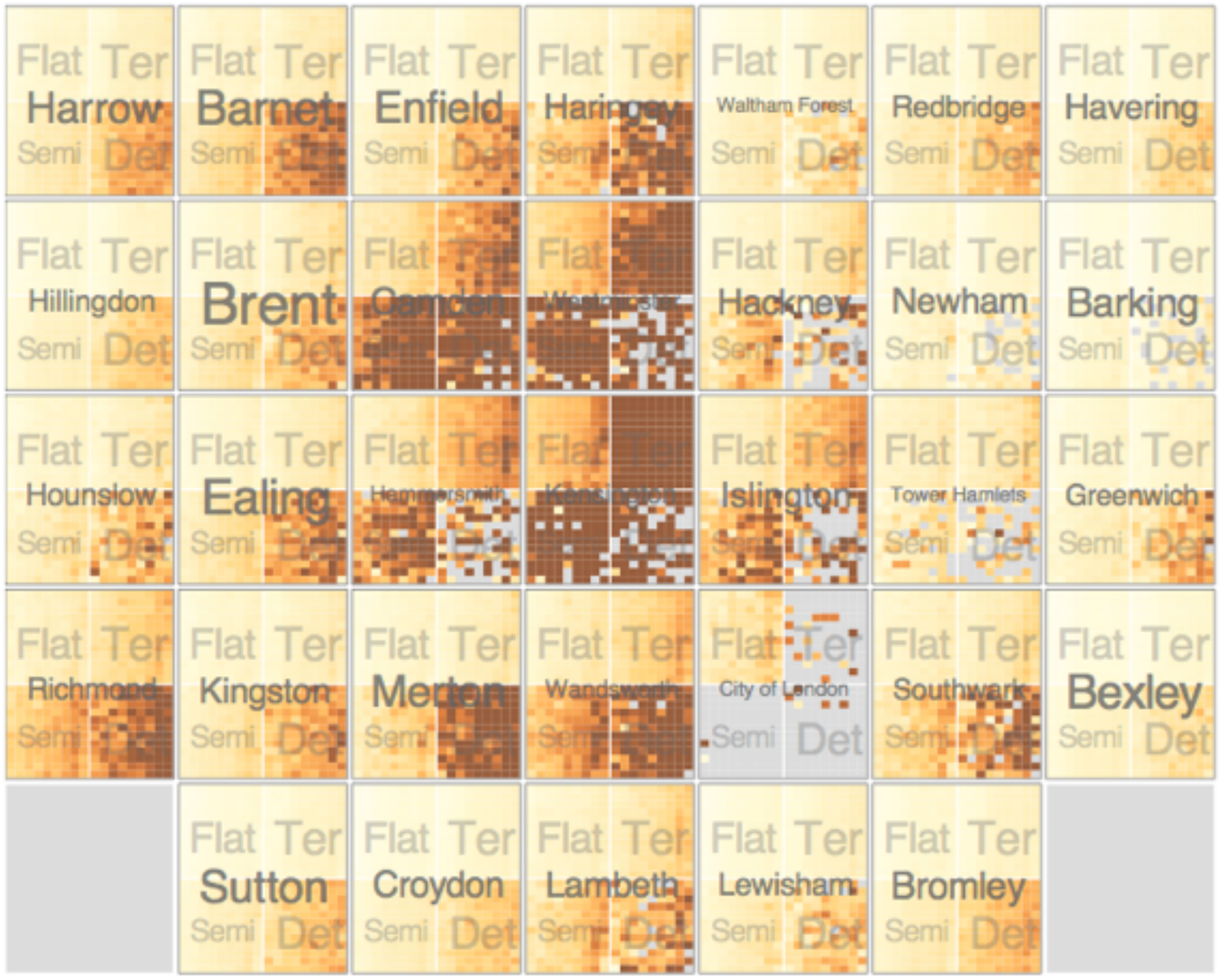
neighborhood location
neighborhood
house type
sale time (year)
sale time (month)

encoding attributes

average price (color)
n/a (size)

results

expensive neighborhoods
near center of city



Slingsby 2009

Configuring Hierarchical Layouts to Address Research Questions

Aidan Slingsby, Jason Dykes and Jo Wood
giCentre, Department of Information Science, City University London
http://www.gicentre.org/hierarchical_layouts/

Configuring Hierarchical Layouts to Address Research Questions

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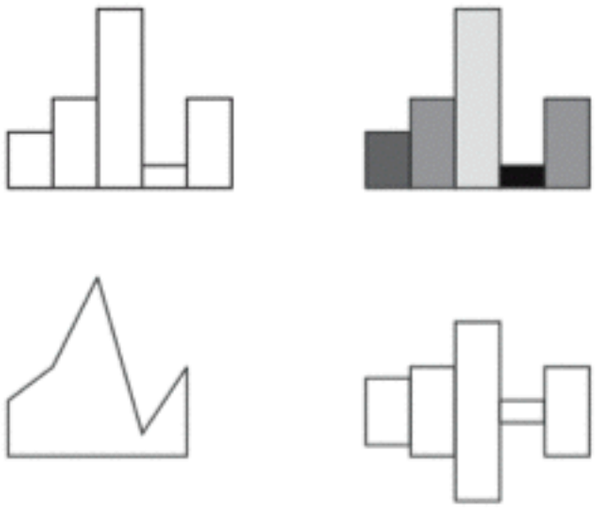
http://www.gicentre.org/hierarchical_layouts/

GLYPHS

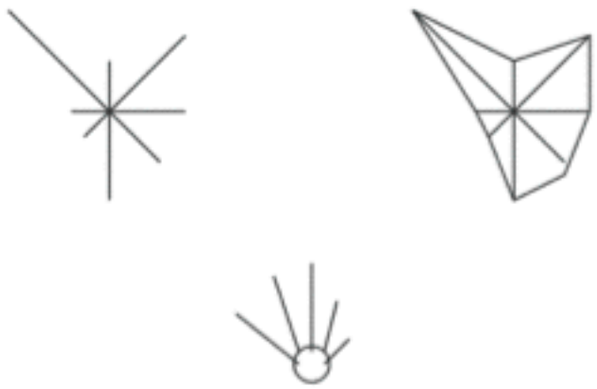
a graphical object with internal structure
that arises from multiple marks

ambiguity

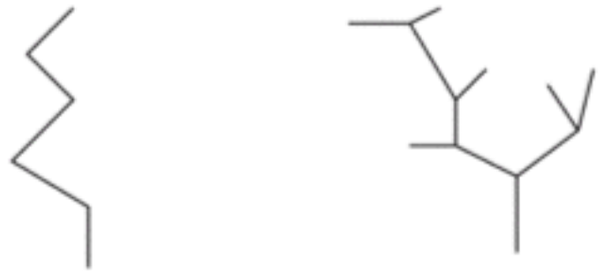
no distinct line between *glyph* and *view*!



Variations on Profile glyphs

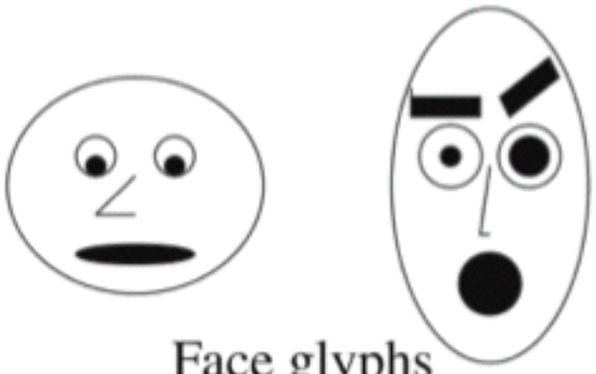


Stars and Anderson/metroglyphs



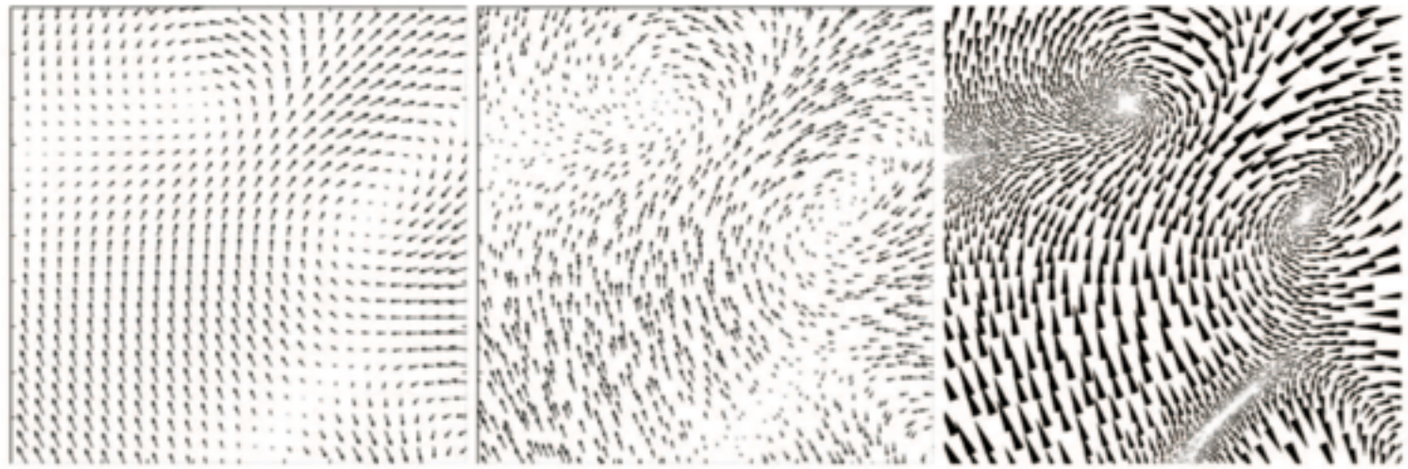
Sticks and Trees

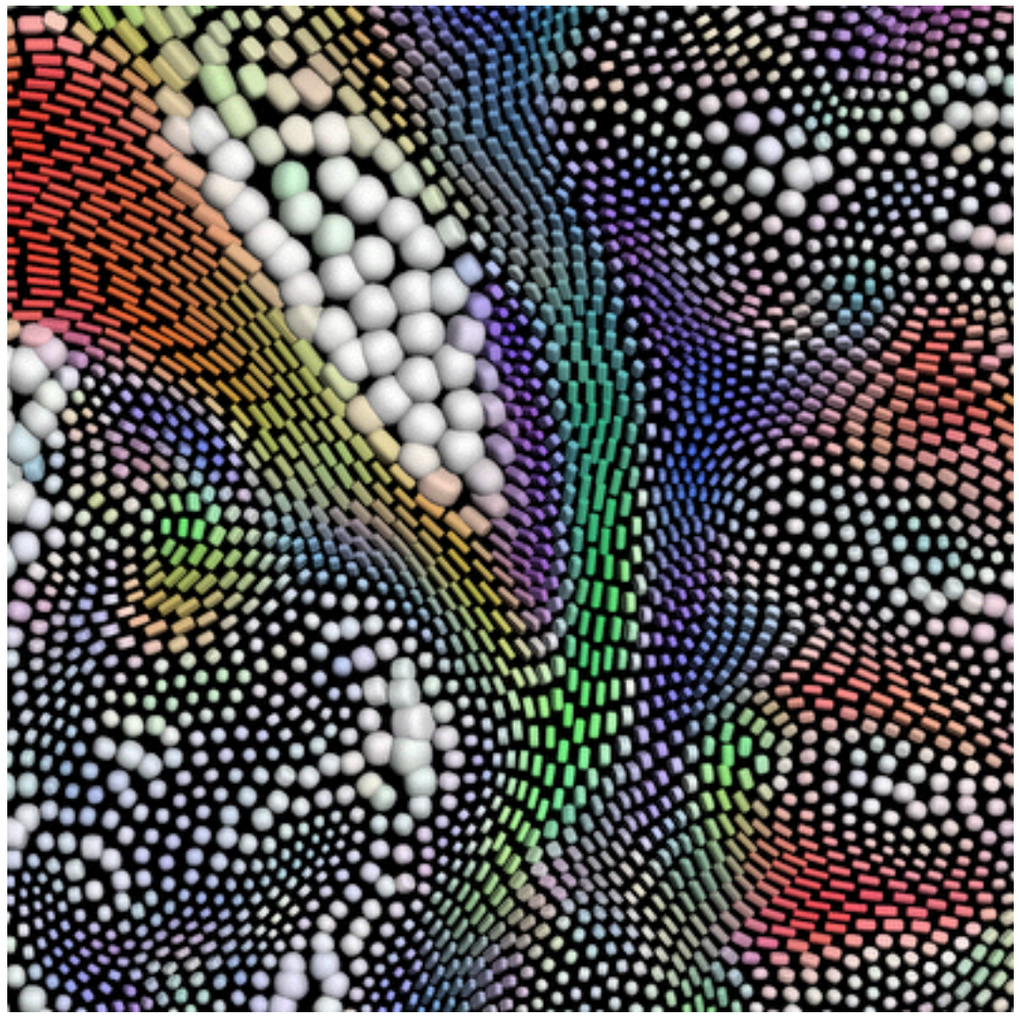
Autoglyph and box glyph



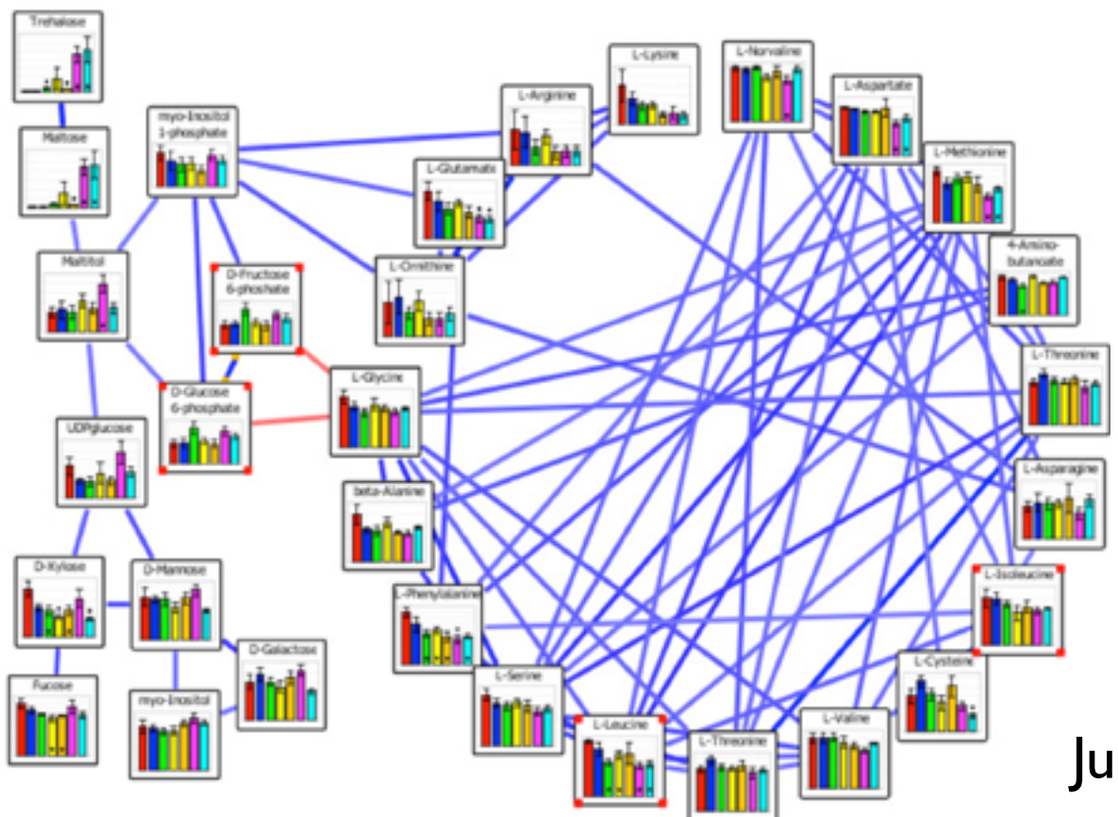
Face glyphs

Arrows and Weathervanes





Kindlmann 2006



Junker 2006

Taxonomy-Based Glyph Design — with a Case Study on Visualizing Workflows of Biological Experiments

Eamonn Maguire, Philippe Rocca-Serra, Susanna-Assunta Sansone, Jim Davies, and Min Chen

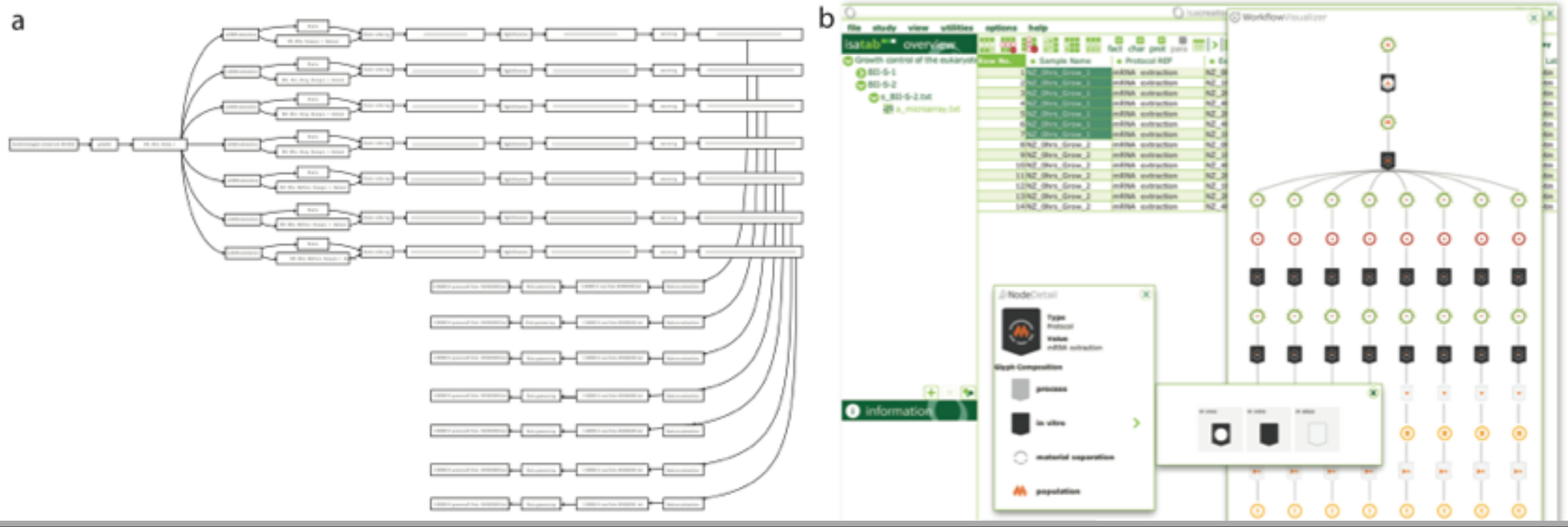


Fig. 1. a Workflows represented using our taxonomy-based glyphs. b We propose to replace the existing glyphs with glyphs, while allowing interactive access to detailed descriptions. This makes it easy to gain an overview, search components and compare workflows. The screenshot shows a prototype developed within ISAcreator, a system for capturing biological experiment metadata.

Abstract—Glyph-based visualization can offer elegant and concise presentation of multivariate information while enhancing speed and ease in visual search experienced by users. As with icon designs, glyphs are usually created based on the designers' experience and intuition, often in a spontaneous manner. Such a process does not scale well with the requirements of applications where a large number of concepts are to be encoded using glyphs. To alleviate such limitations, we propose a new systematic process for glyph design by exploring the parallel between the hierarchy of concept categorization and the ordering of discriminative capacity of visual channels. We examine the feasibility of this approach in an application where there is a pressing need for an efficient and effective means to visualize workflows of biological experiments. By processing thousands of workflow records in a public archive of biological experiments, we demonstrate that a cost-effective glyph design can be obtained by following a process of formulating a taxonomy with the aid of computation, identifying visual channels hierarchically, and defining application-specific abstraction and metaphors.

Index Terms—Glyph-based techniques, taxonomies, design methodologies, bioinformatics visualization.

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
S0
Inputs and Outputs
Process
S7
Biological
Device
Chemical
Data
S6
In Vitro
In Vivo
In Silico
S3
Data Collection
Data Processing
Data Analysis
S2
Material perturbation
Material separation
Material amplification
Material combination
Material collection
S5
Molecule.
Cellular Part
Cell
Tissue
Organ
Organism
Population

- view choices
- partitioning
- layering

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

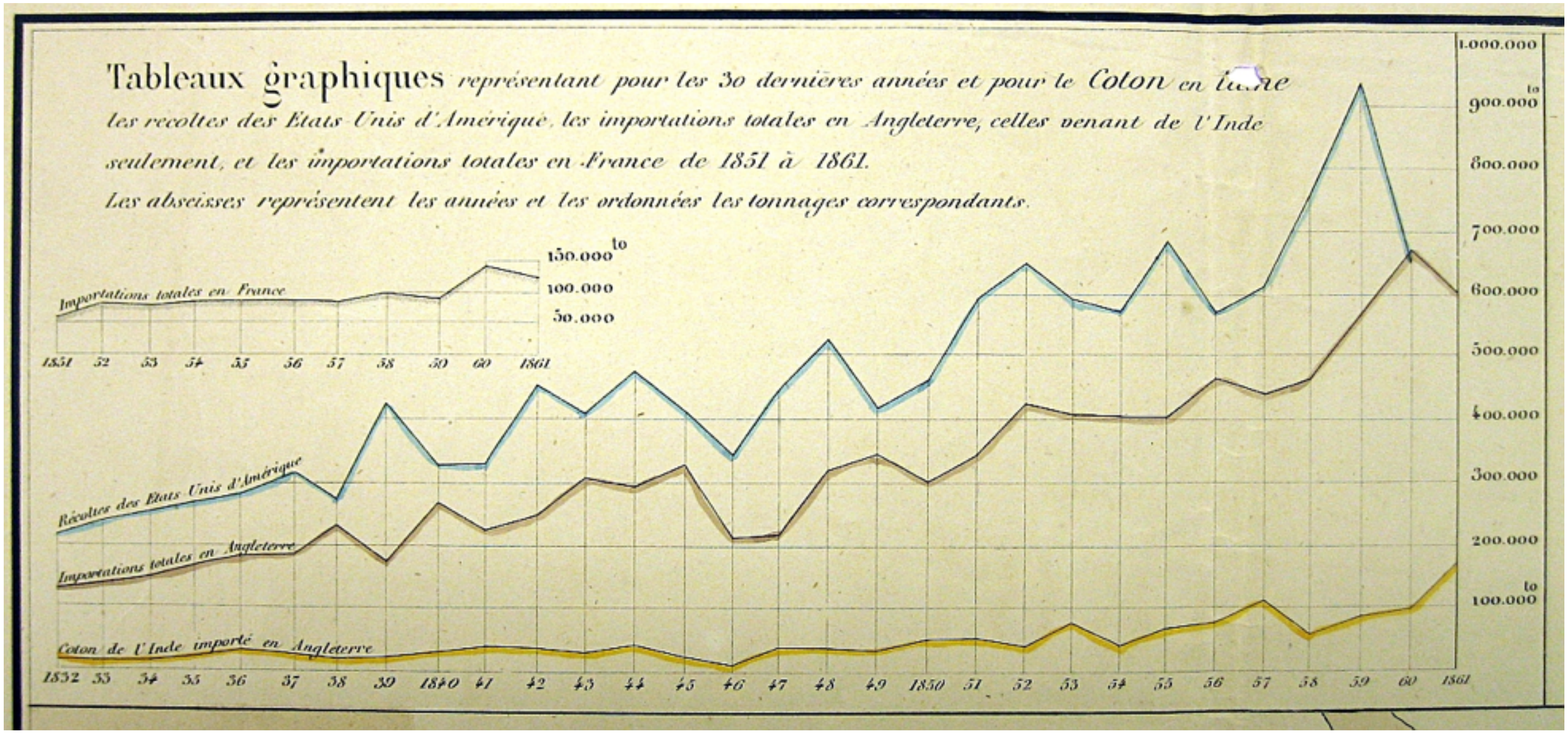
trade-off

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

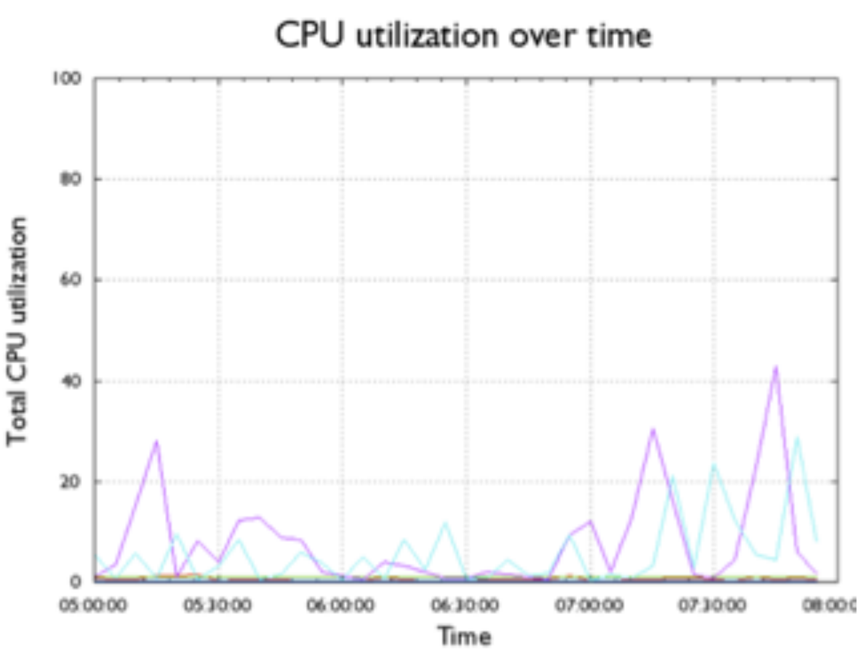
GLOBAL COMPOSITING

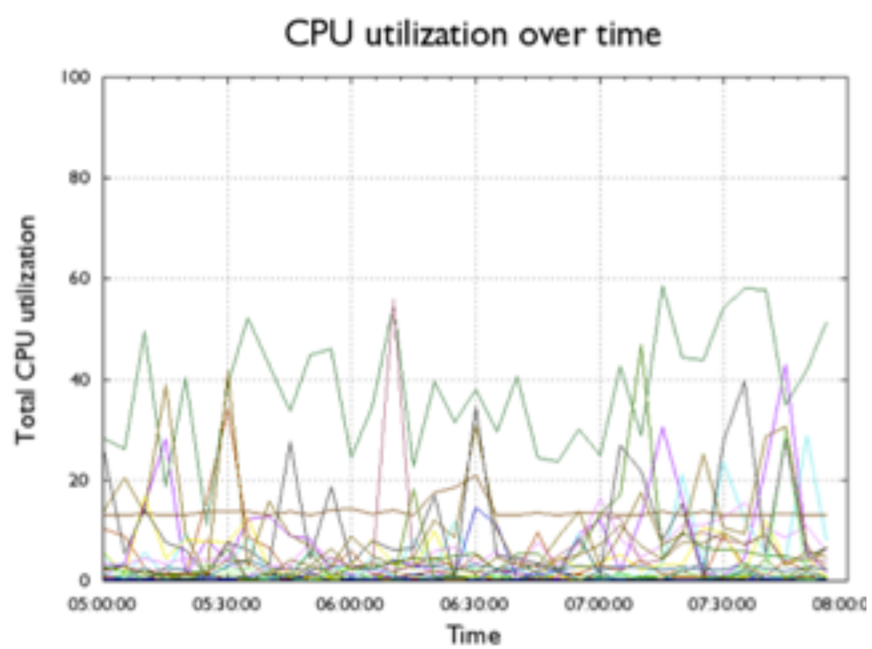
JOSEPH MINARD

1781-1870



overlays


CPU utilization over time
Total CPU utilization
Time
100
80
60
40
20
0
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00


CPU utilization over time
Total CPU utilization
Time
100
80
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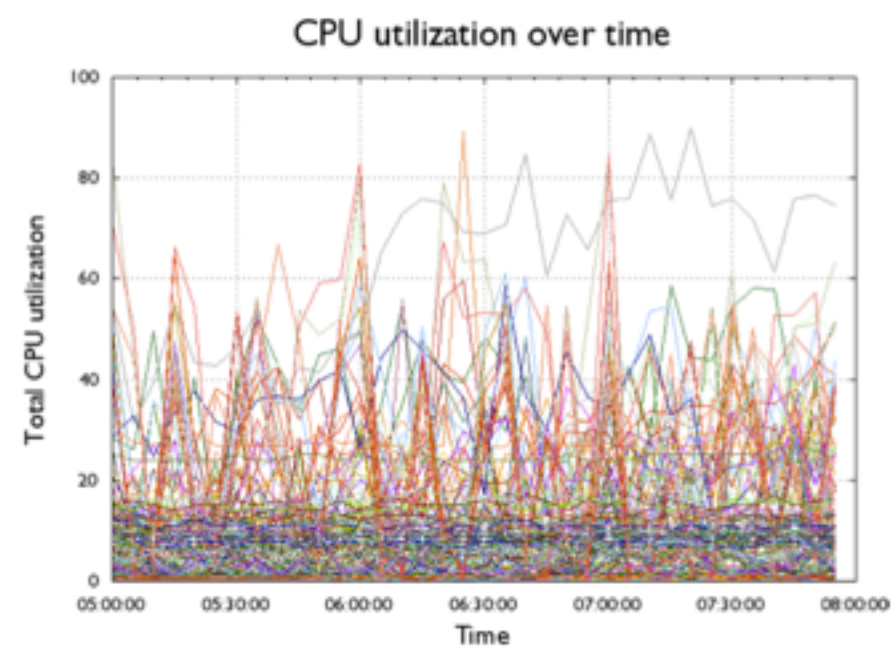
CPU utilization over time
Total CPU utilization
Time
100
80
60
40
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0
05:00:00
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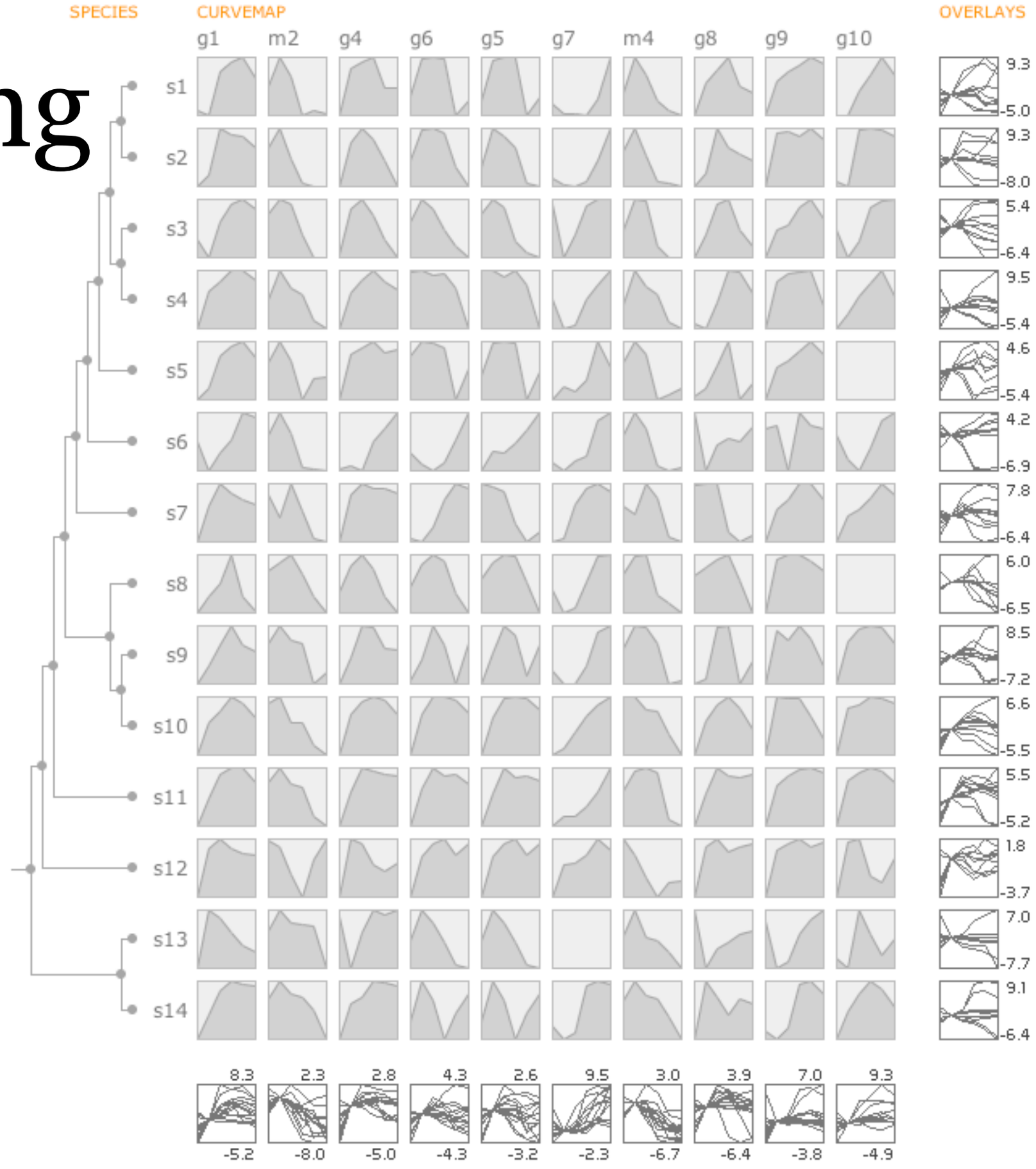
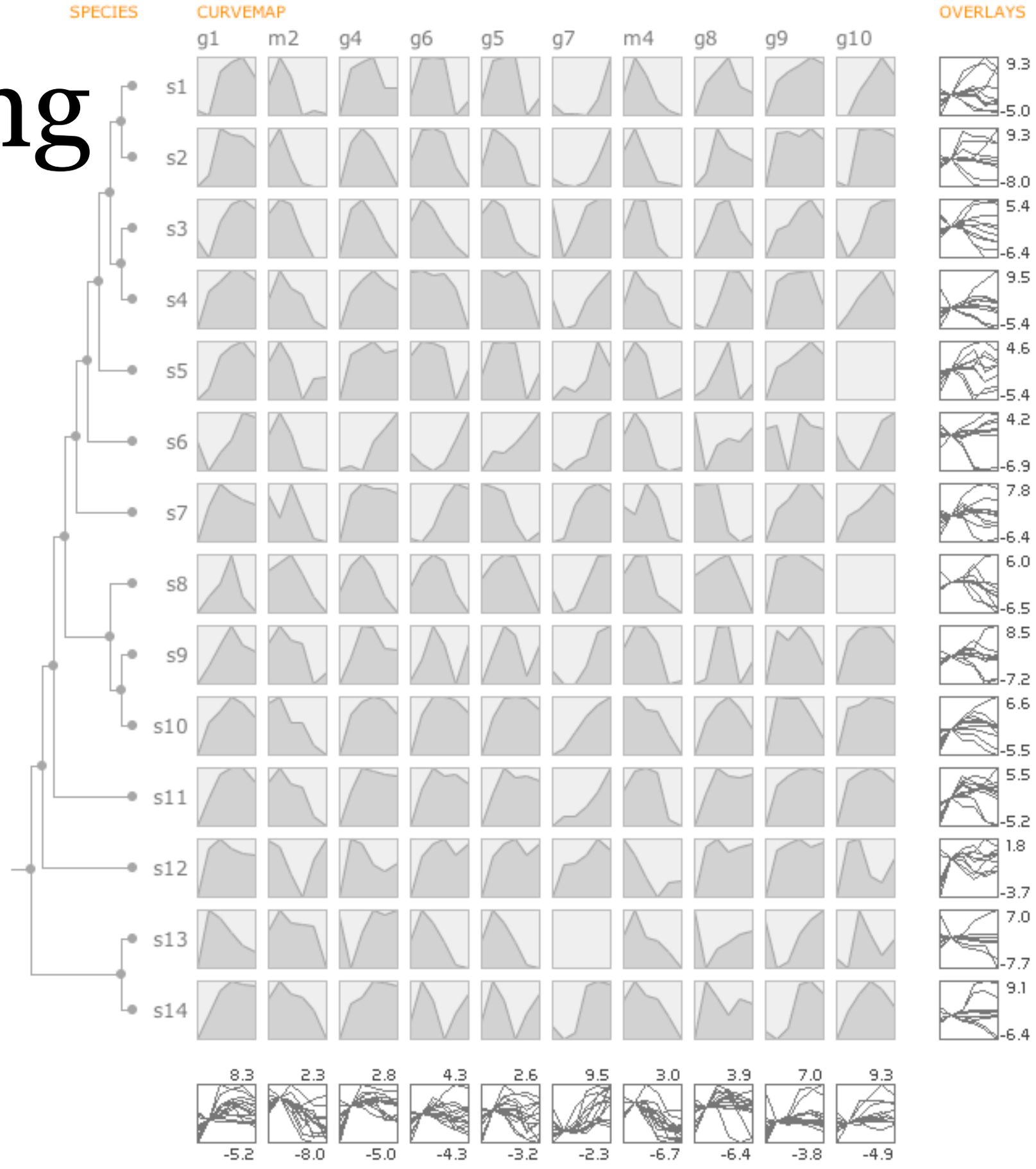
07:30:00
08:00:00

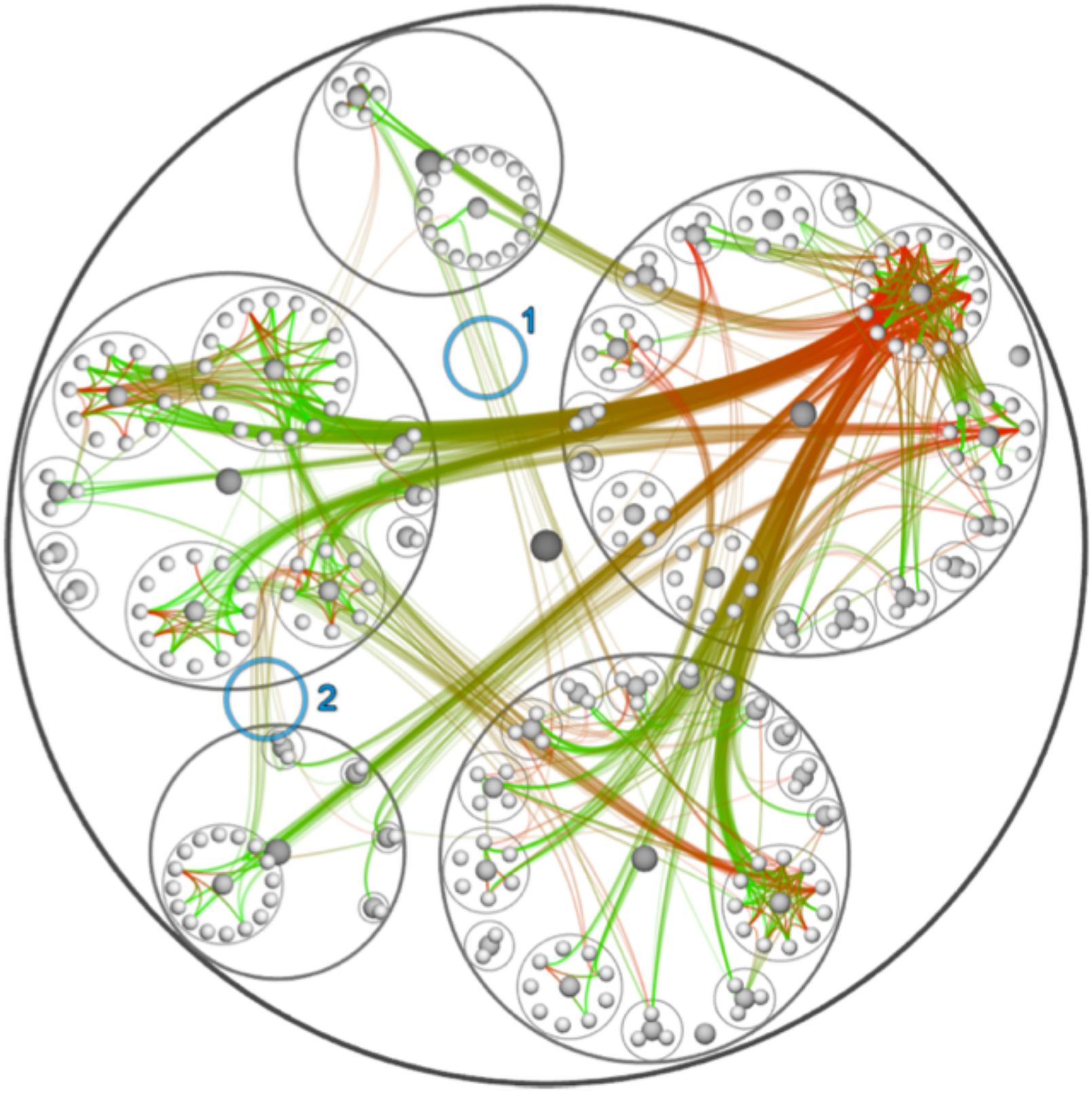
highlighting



highlighting

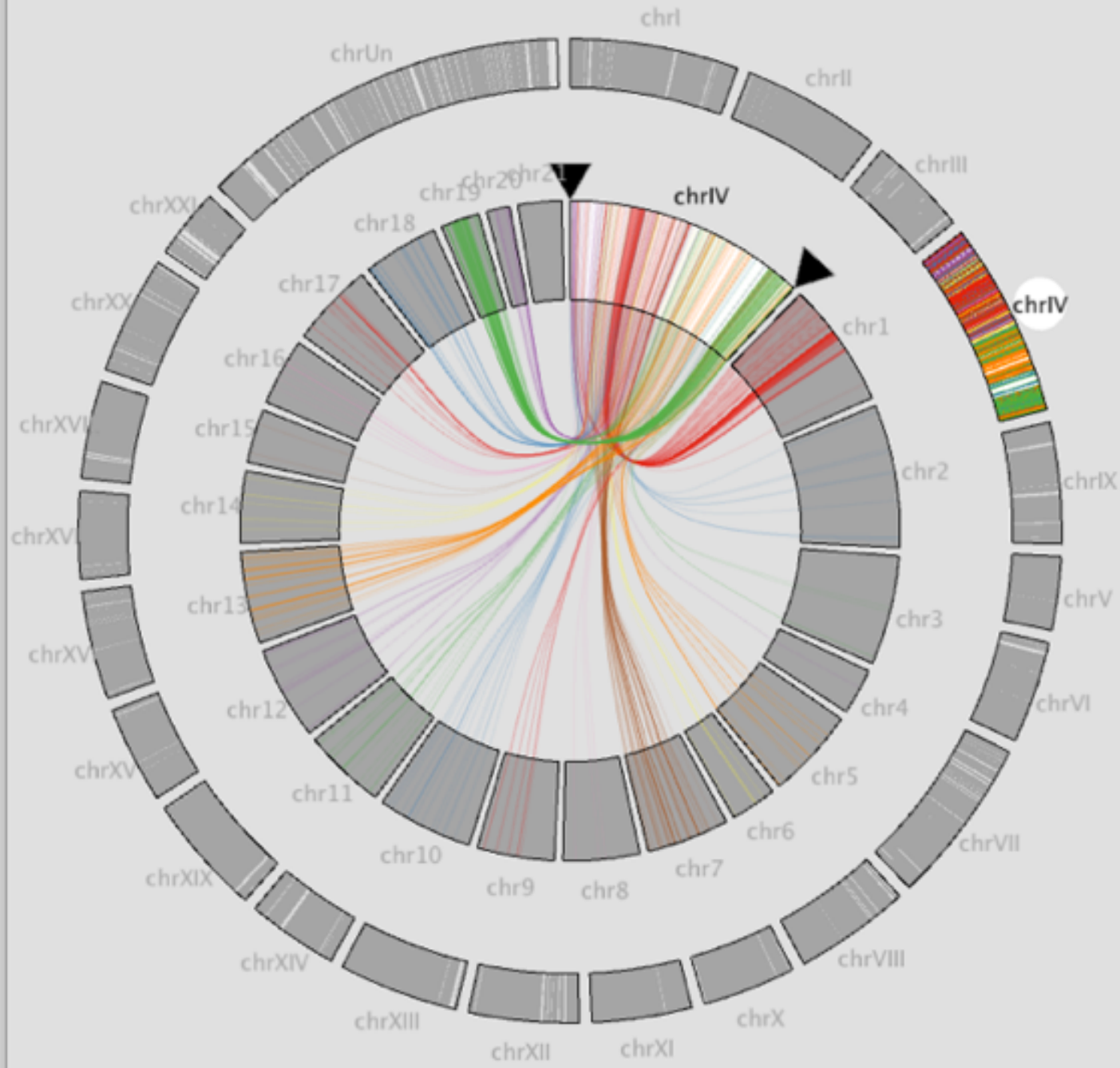


edge bundling



Holton 2006

SyntenyViewer



Indie 2

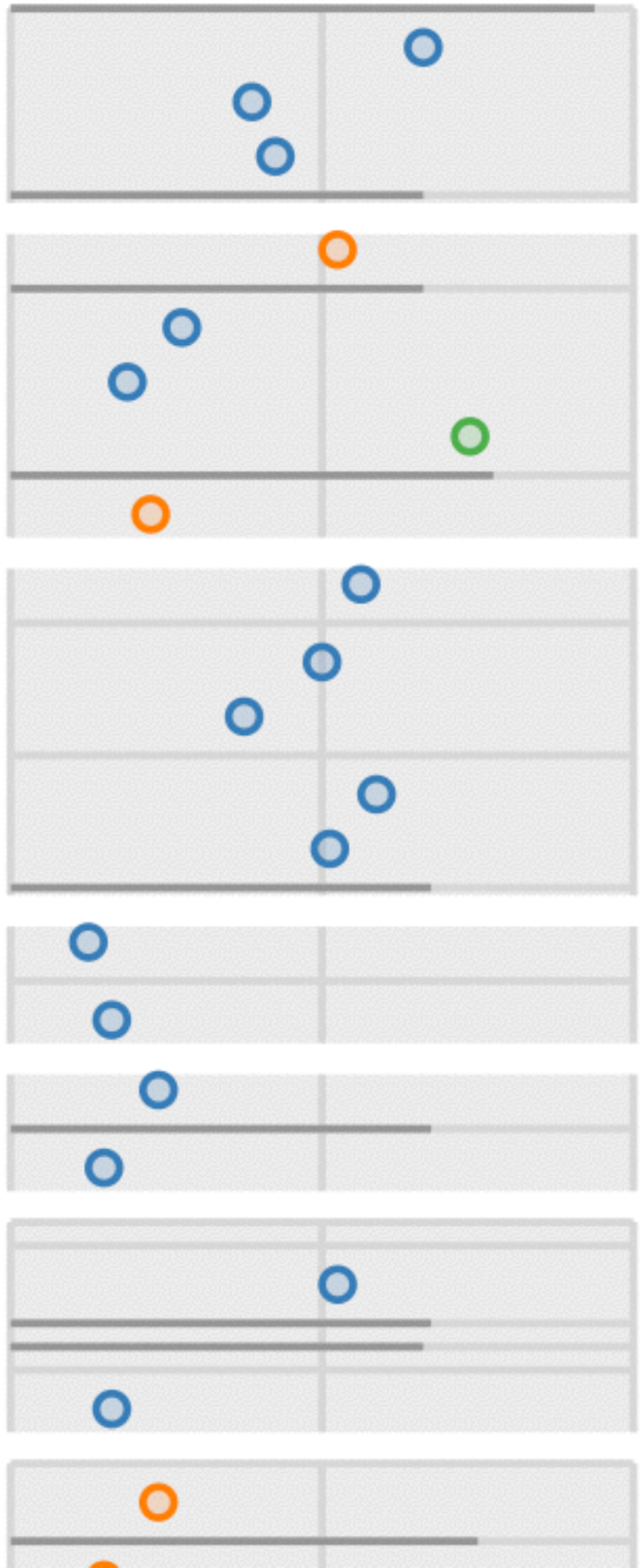
0.37 CP1 pos

0.41 CP2 pos

0.94 curve tightness

0.12 curve alpha

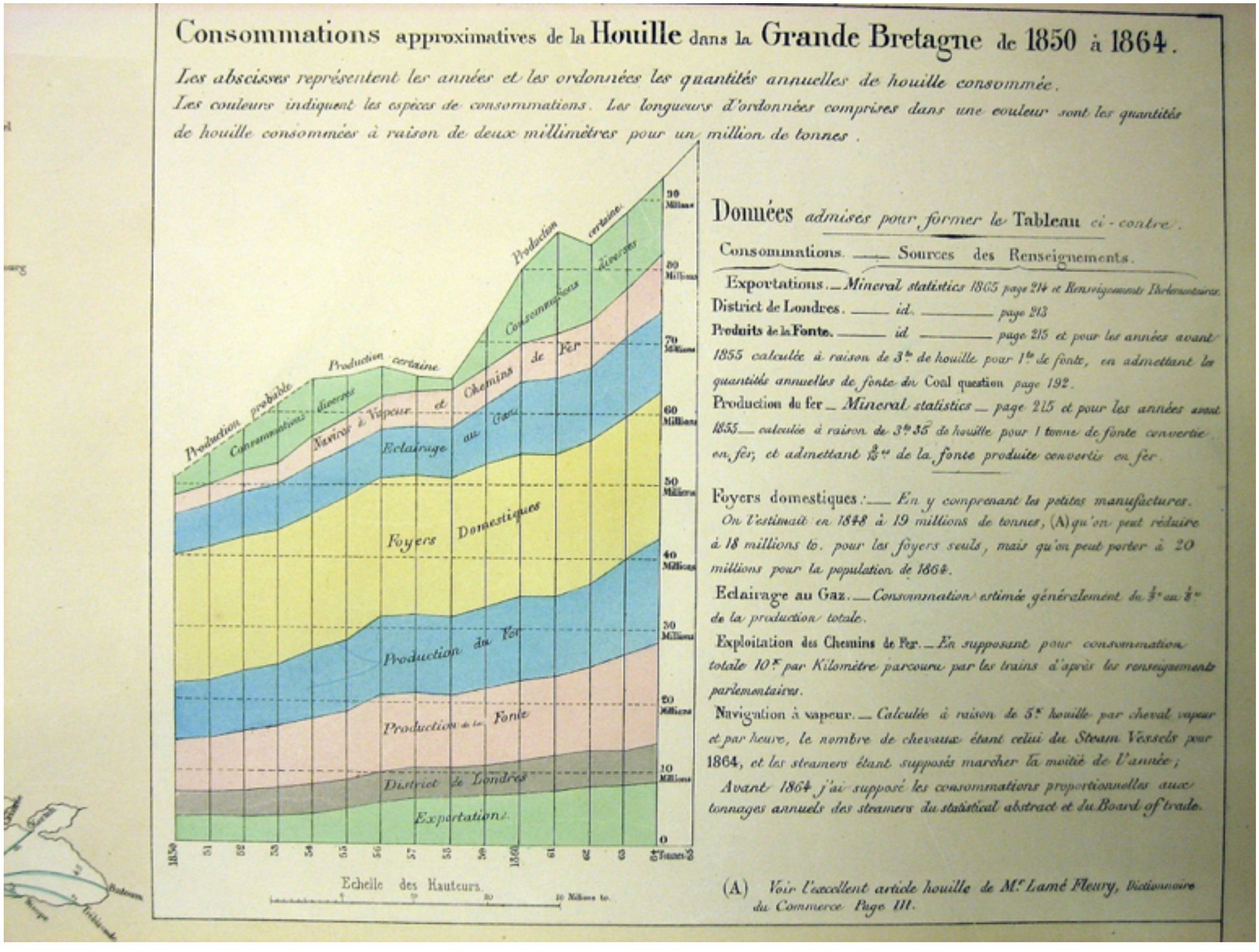
multiple encodings



ITEM-LEVEL STACKING

JOSEPH MINARD

1781-1870



How Different Groups Spend Their Day - Interactive Graphic - NYTimes.com

www.nytimes.com/interactive/2009/07/31/business/20080801-metrics-graphic.html

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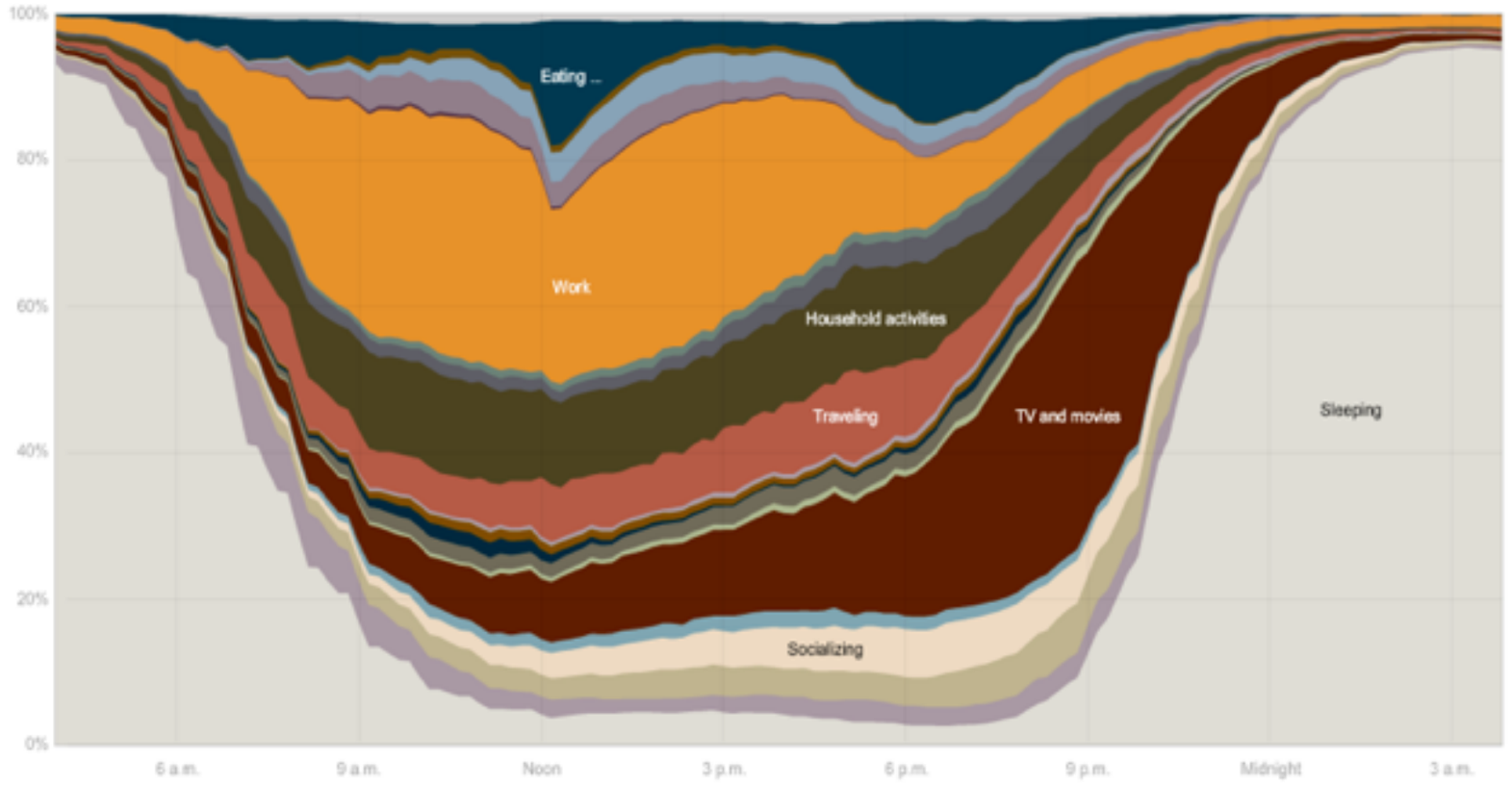
How Different Groups Spend Their Day

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

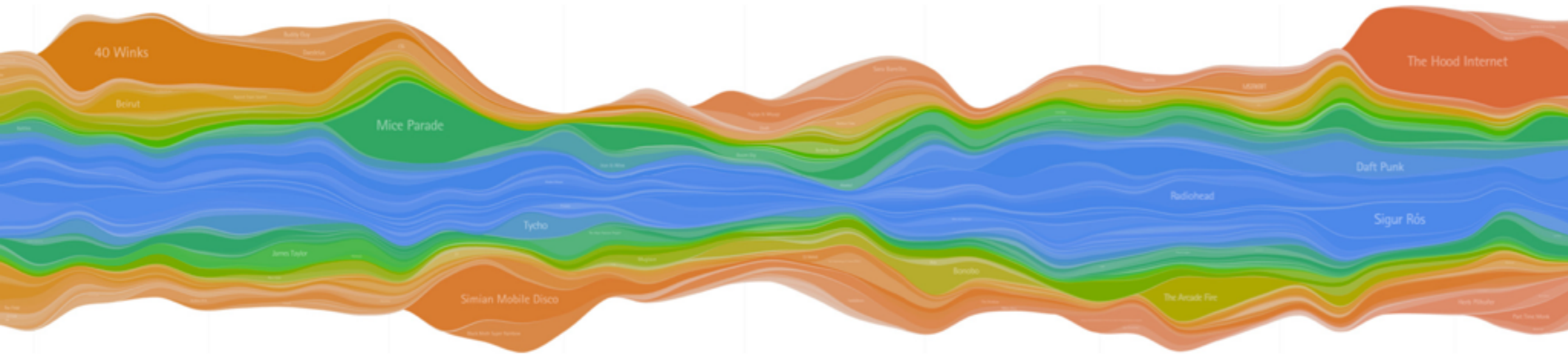
Sleeping, eating, working and watching television take up about two-thirds of the average day.

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



By SHAN CARTER, AMANDA COX, KEVIN QUEALY and AMY SCHOENFELD | Send Feedback

streamgraph



Byron 2008

New York Times – Ebb and Flow at the Box Office

Just in time for the Academy Awards, the **Stream Graph** technique was applied to a data set containing the revenue per week for every movie released in 2007. The resulting graphic spanned the length of the New York Times for Sunday, February 24th, written and edited by Amanda Cox.

The summer, thanksgiving and winter holidays have the most box office hits. Box office hits peak high and fall quickly, as the result of hyped advertising. Movies which are nominated for Academy Awards tend to not peak very high, but have a much longer fall off, often remaining in theaters for months.

Supporting interactive graphic

Collaborated With

Amanda Cox
Matthew Bloch
Shawn Carter

Related Project

Listening History
December 2006

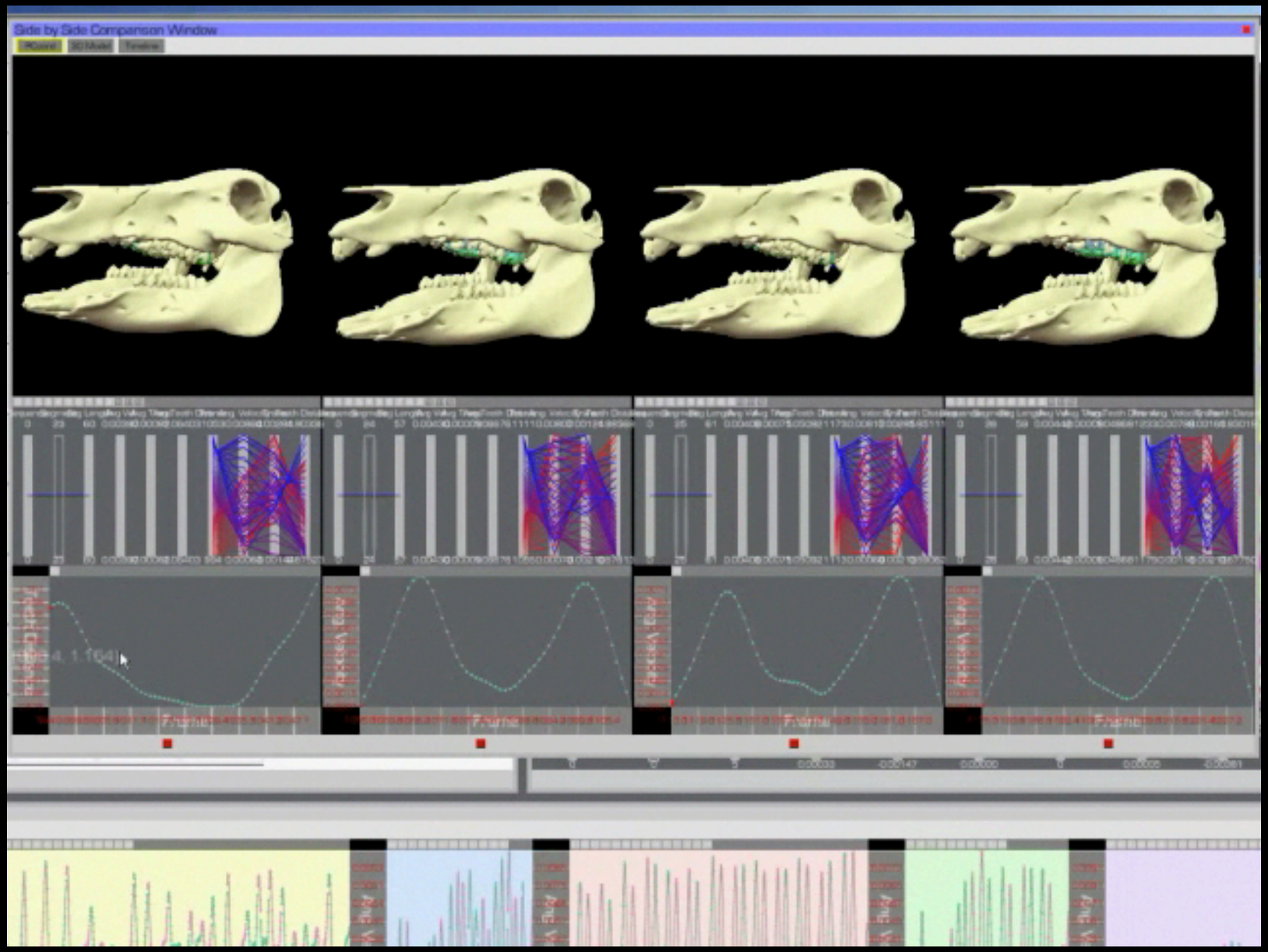
Next Project

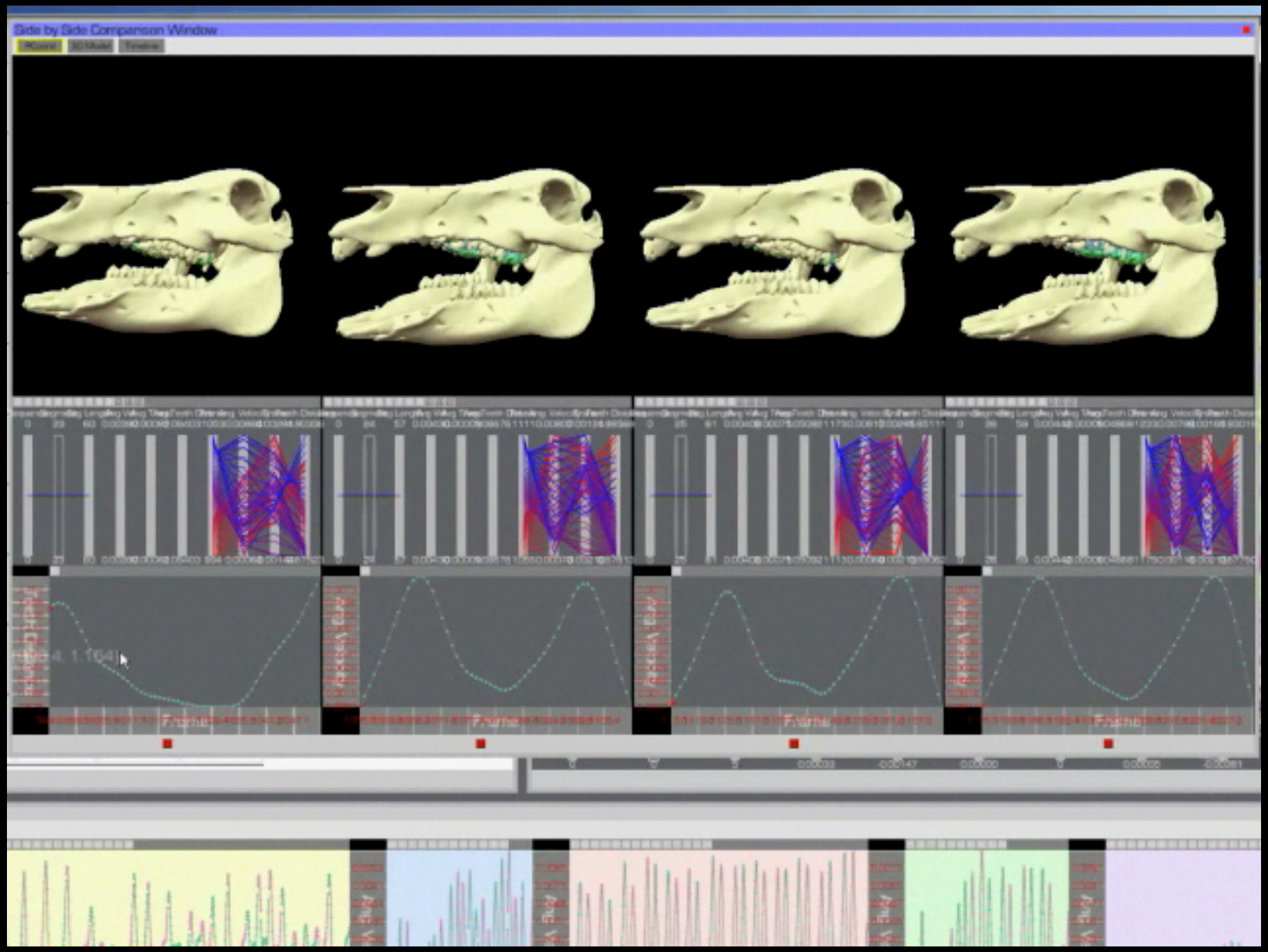
Experimental Form
March 2008

Previous Project

Flirtastic
December 2007

critique


Side by Side Comparison Window


Side by Side Comparison Window

L10: Focus + Context

REQUIRED READING

Chapter 14

Embed: Focus+Context

14.1 The Big Picture

The family of idioms known as **focus+context** are based on the design choice to **embed** detailed information about a selected set—the **focus**—within a single view that also contains overview information about more of the data—the **context**. The choice to embed is a sophisticated form of item reduction that may intrinsically include all three of the others: aggregation, filtering, and navigation. It may also require selection. A very large family of specific idioms that use some form of focus+context embedding has been proposed.*

The embedding design choice cannot be fully understood when considered purely from the visual encoding point of view *or* purely from the interaction point of view; it is fundamentally a synthesis of both. The key idea of focus+context is that the focus set changes dynamically as the user interacts with the system, and thus the visual representation also changes dynamically. Many of the idioms involve indirect control, where the focus set is inferred via the combination of the user's navigation choices and the inherent structure of the dataset.

The most fundamental design choice for embedding is whether

★ Many names are essentially synonyms for or special cases of *focus+context*: bifocal displays, degree-of-interest models, detail in context, distortion-oriented presentations, distortion viewing, elastic presentation spaces, fisheye lens, generalized fisheye