CS-5630 / CS-6630 Visualization for Data Science
Views

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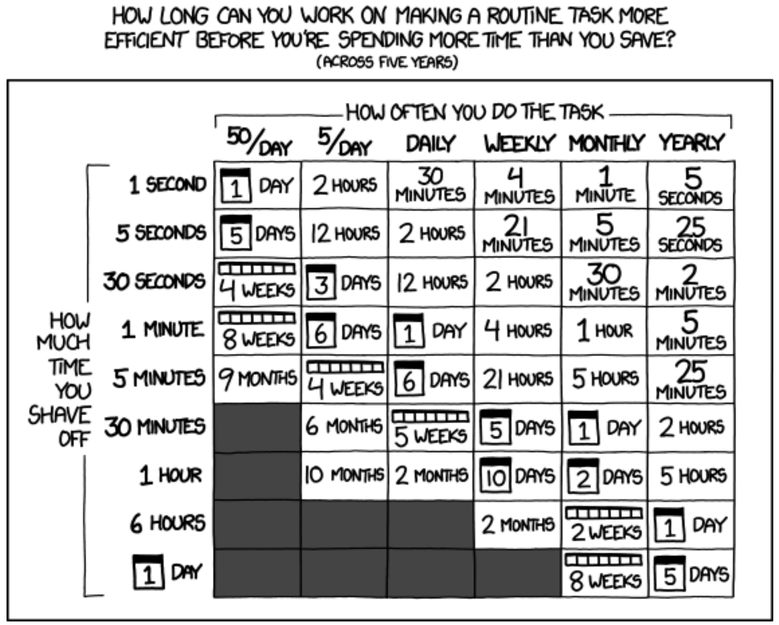
THE UNIVERSITY OF UTAH



[xkcd]

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

Linked Views

Multiple Views that are simultaneously visible and linked together such that actions in one view affect the others.

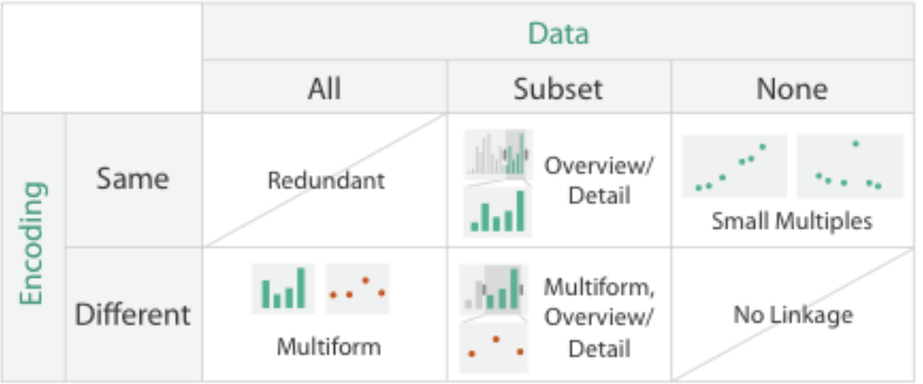
Linked Views Options

highlighting: to link, or not

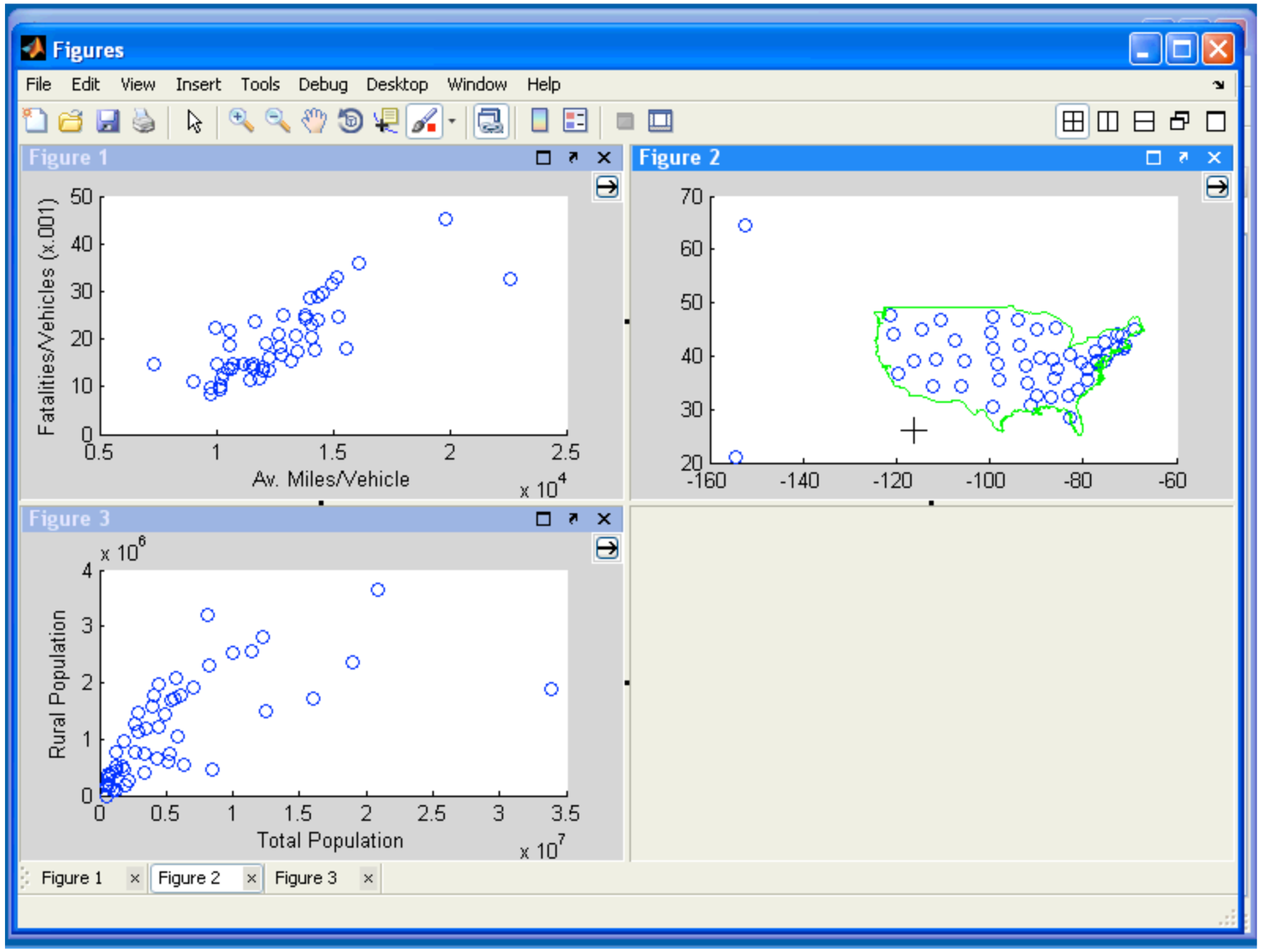
navigation: to share, or not

encoding: same or multiform

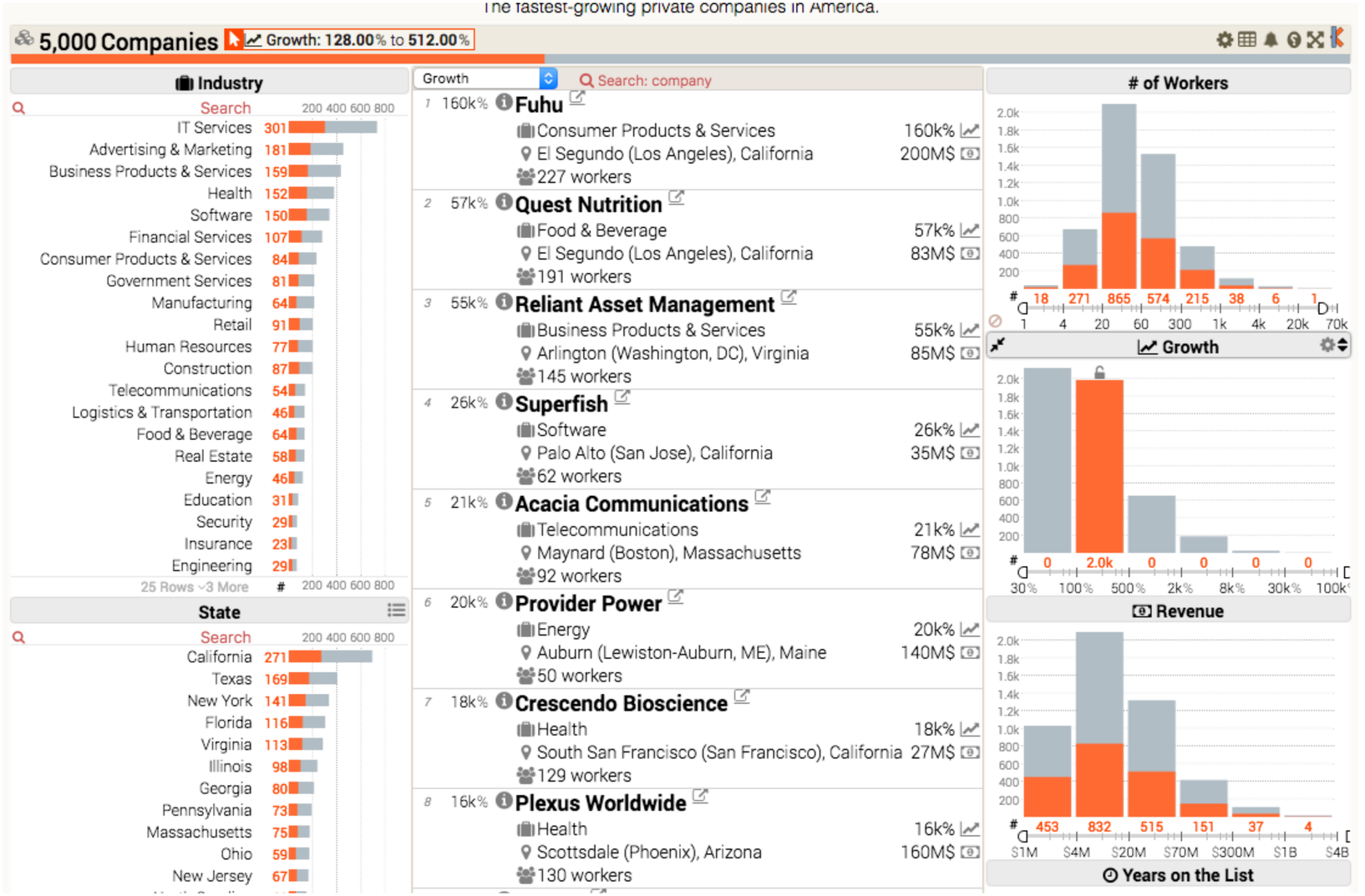
dataset: share all, subset, or none



Linked Highlighting



Linked Highlighting



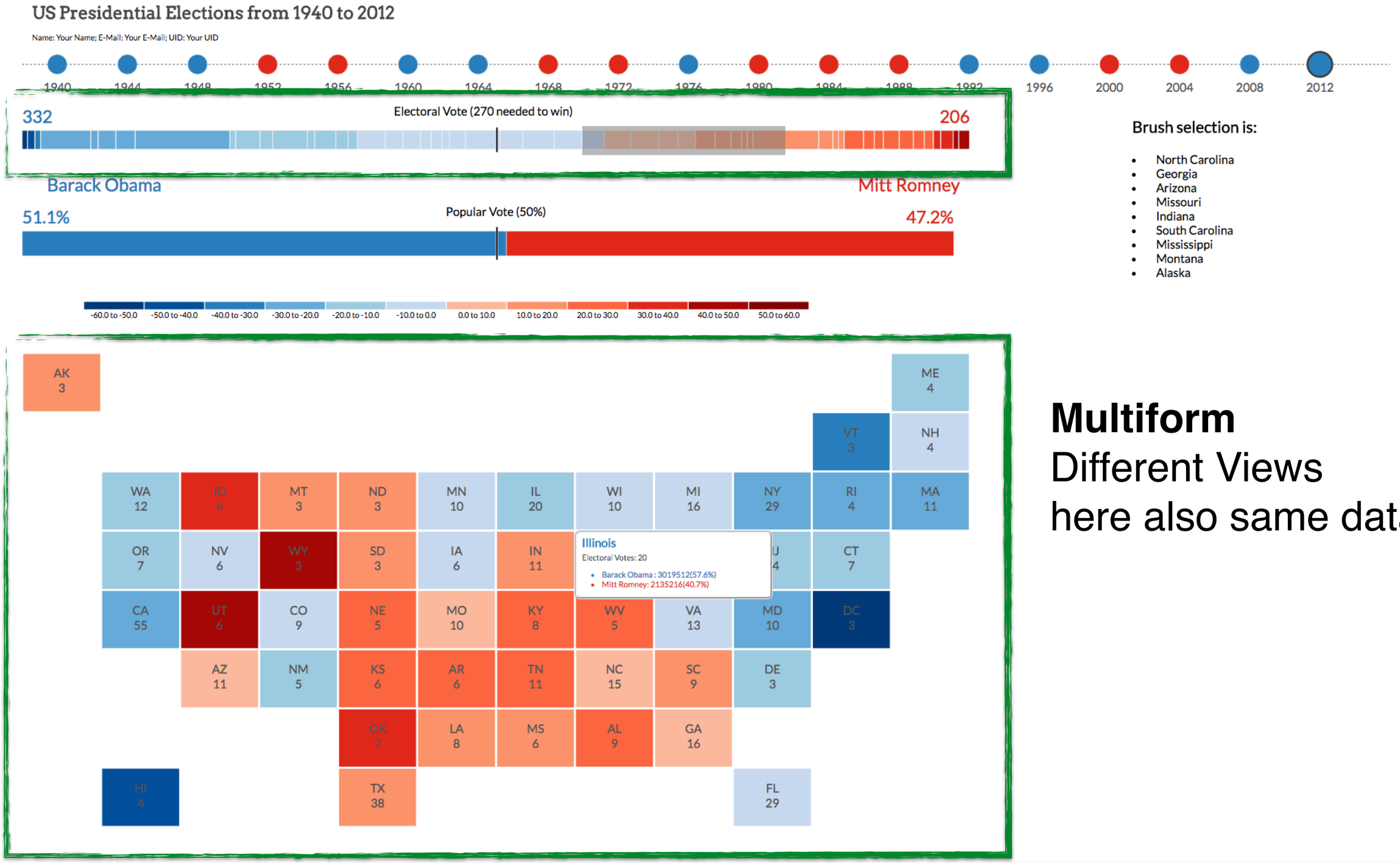
Multiform

difference visual encodings are used between the views

- implies shared data
- either all data
- or subset of data (overview + detail)

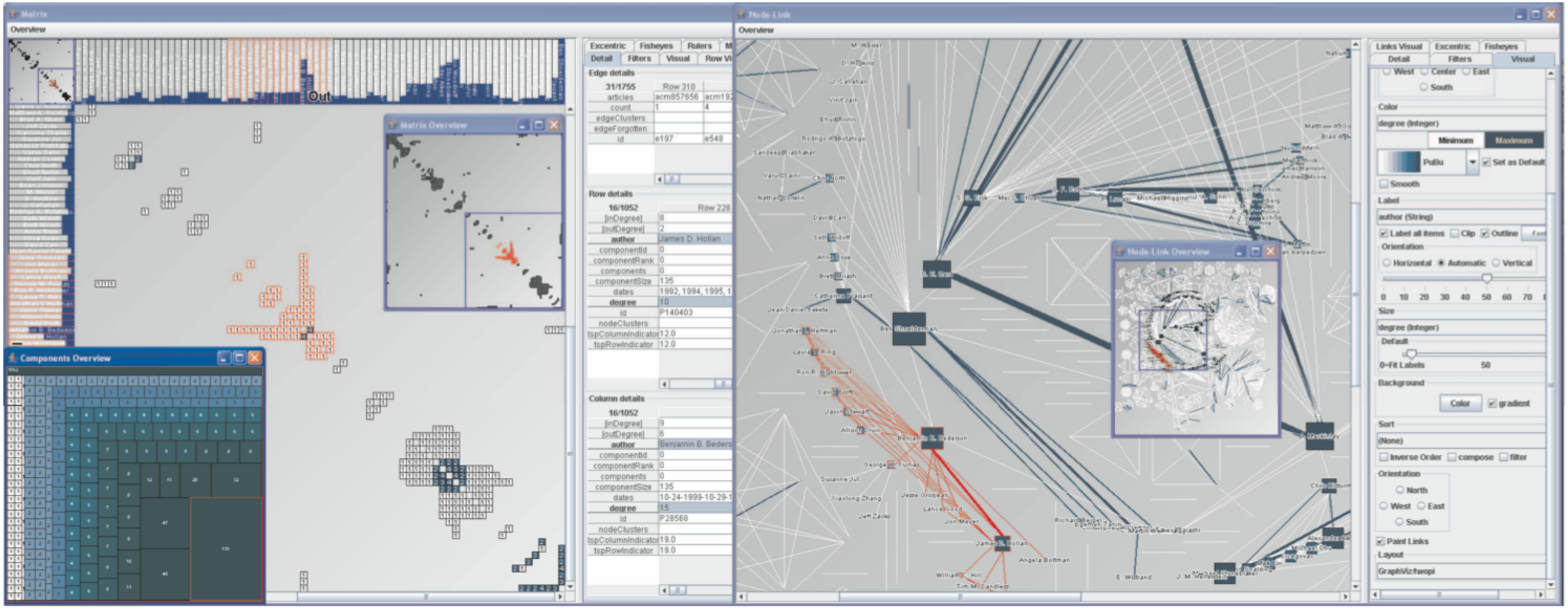
rational:
single, monolithic view has strong limits on the number of attributes that can be shown simultaneously

different views support different tasks



Multiform
Different Views
here also same data

MatrixExplorer



Same Data - Different Idioms (Multiform)

Henry 2006

demo.caleydo.org/pathfinder/main.html#uc=dblp

Pathfinder

Start Hanspeter Pfis End Ben Shneiderm Advanced Query

Length	0	1	2	3	4
Paths	0	0	0	3	105

Path List

1. Hanspeter Pfiste — Frank van Ham — Adam Perer — Ben Shneiderma (3)
   - CHI
   - TVCG
   - chi_publications (1, 0, 8, 38)
   - cited
   - degree
   - tvcg_publication
1. Hanspeter Pfiste — Krzysztof Z. Gajc — Desney S. Tan — Ben Shneiderma (3)
   - CHI
   - TVCG
   - chi_publications
   - cited
   - degree
   - tvcg_publication
1. Hanspeter Pfiste — Jean-Daniel Feke — Catherine Plaisa — Ben Shneiderma (3)
   - CHI
   - TVCG
   - chi_publications
   - cited
   - degree
   - tvcg_publication
4. Hanspeter Pfiste — Jean-Daniel Feke — Catherine Plaisa — Jennifer Golbeck — Ben Shneiderma (4)
   - CHI
   - TVCG
   - chi_publications
   - cited
   - degree
   - tvcg_publication
4. Hanspeter Pfiste — Jean-Daniel Feke — Wendy E. Macka — Ed Huai-hsin Ch — Ben Shneiderma (4)
   - CHI
   - TVCG
   - chi_publications
   - cited
   - degree
   - tvcg_publication
4. Hanspeter Pfiste — Krzysztof Z. Gajc — Jeffrey Heer — Ed Huai-hsin Ch — Ben Shneiderma (4)
   - CHI
   - TVCG
   - chi_publications
   - cited
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4. Hanspeter Pfiste — Krzysztof Z. Gajc — Jeffrey Heer — Stuart K. Card — Ben Shneiderma (4)
   - CHI
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4. Hanspeter Pfiste — Jean-Daniel Feke — Catherine Plaisa — Krist Wongsupha — Ben Shneiderma (4)
   - CHI
   - TVCG
   - chi_publications
   - cited
   - degree
   - tvcg_publication

Path Topology

Active Page | All

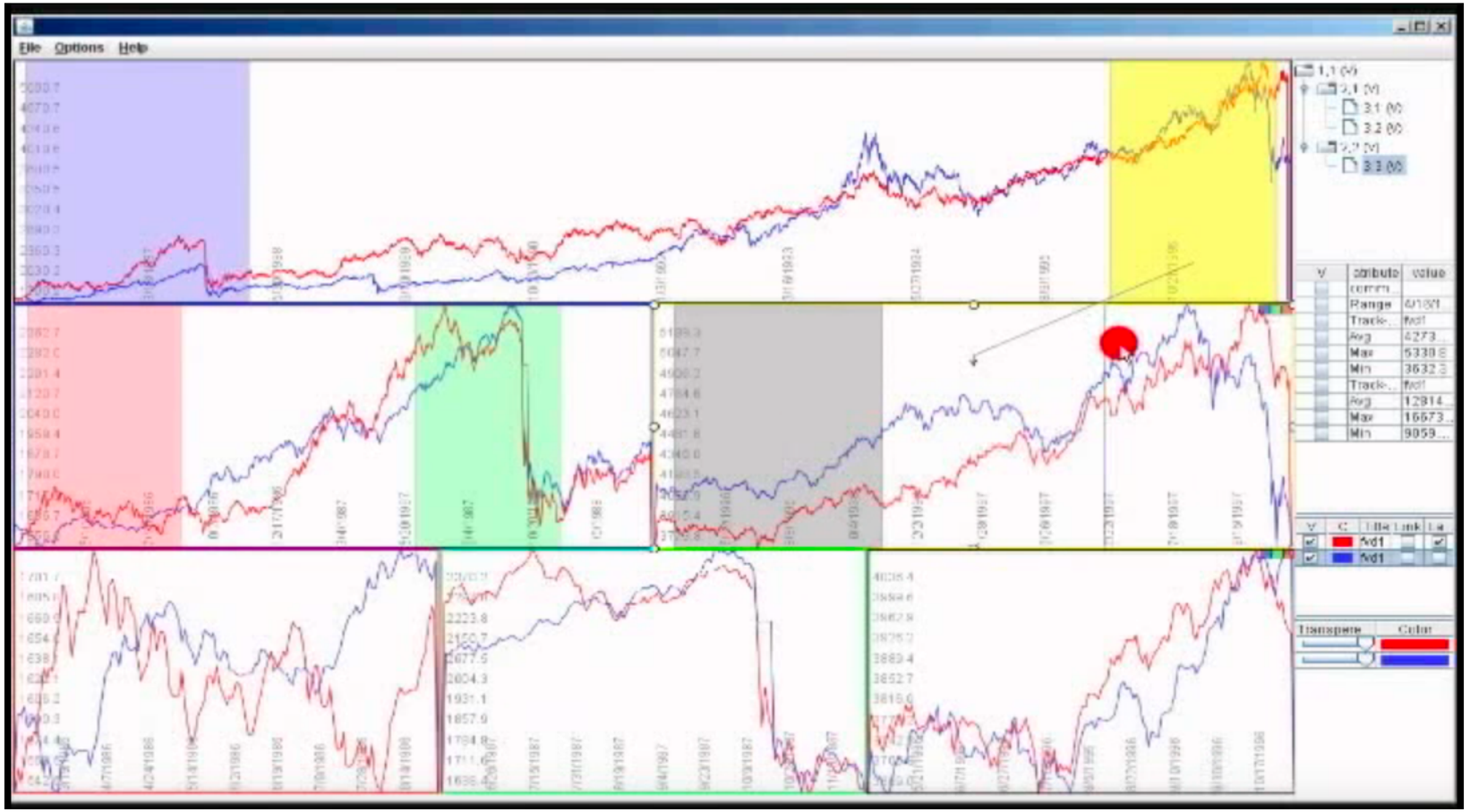
OVERVIEW + DETAIL

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

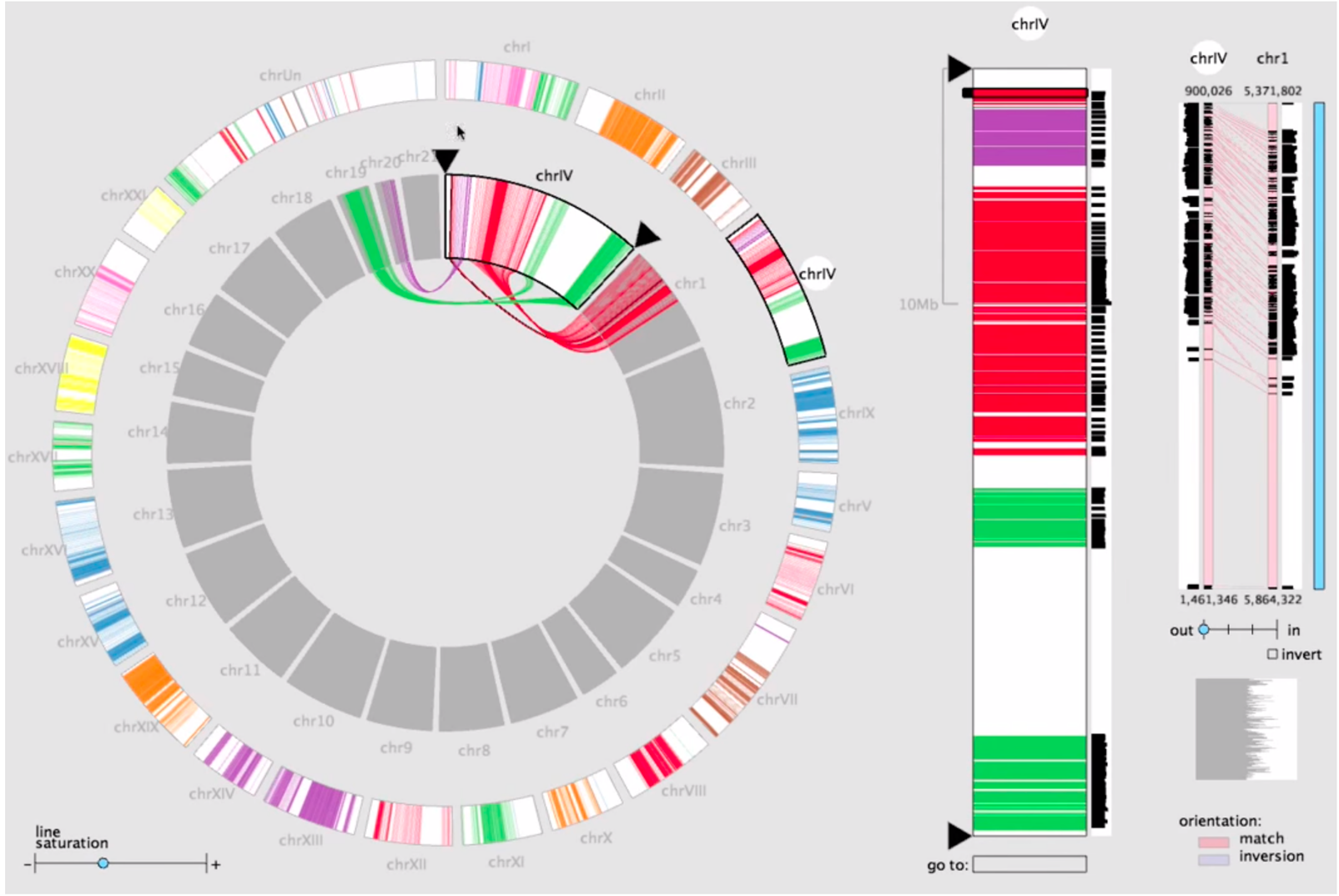
Stack Zooming



Same Data - Same Encoding, Different Resolution

[Javed & Emlqvist, PacificVis, 2010]

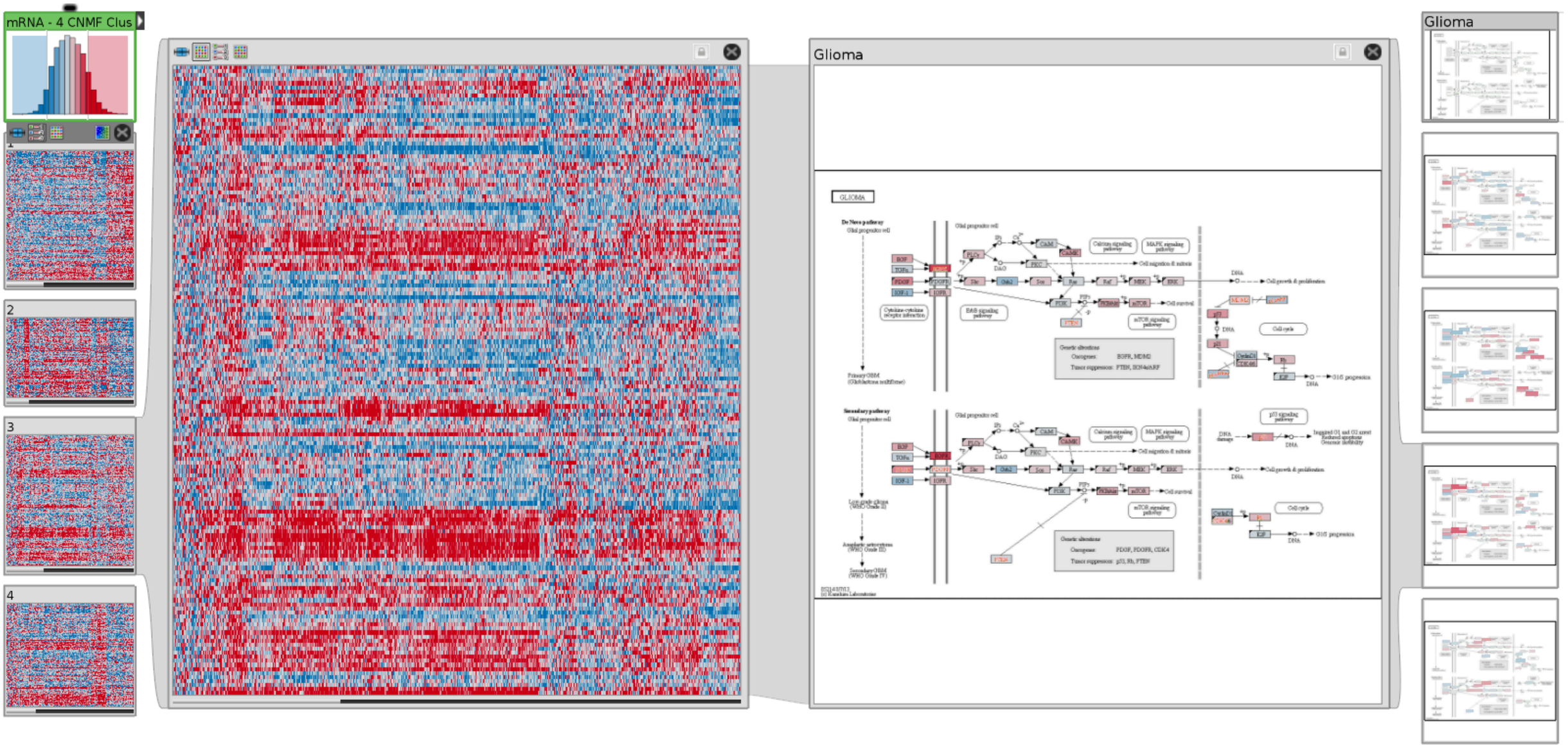
MizBee



Multiform Overview & Detail

[Meyer 2009]

StratomeX



SMALL MULTIPLES

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

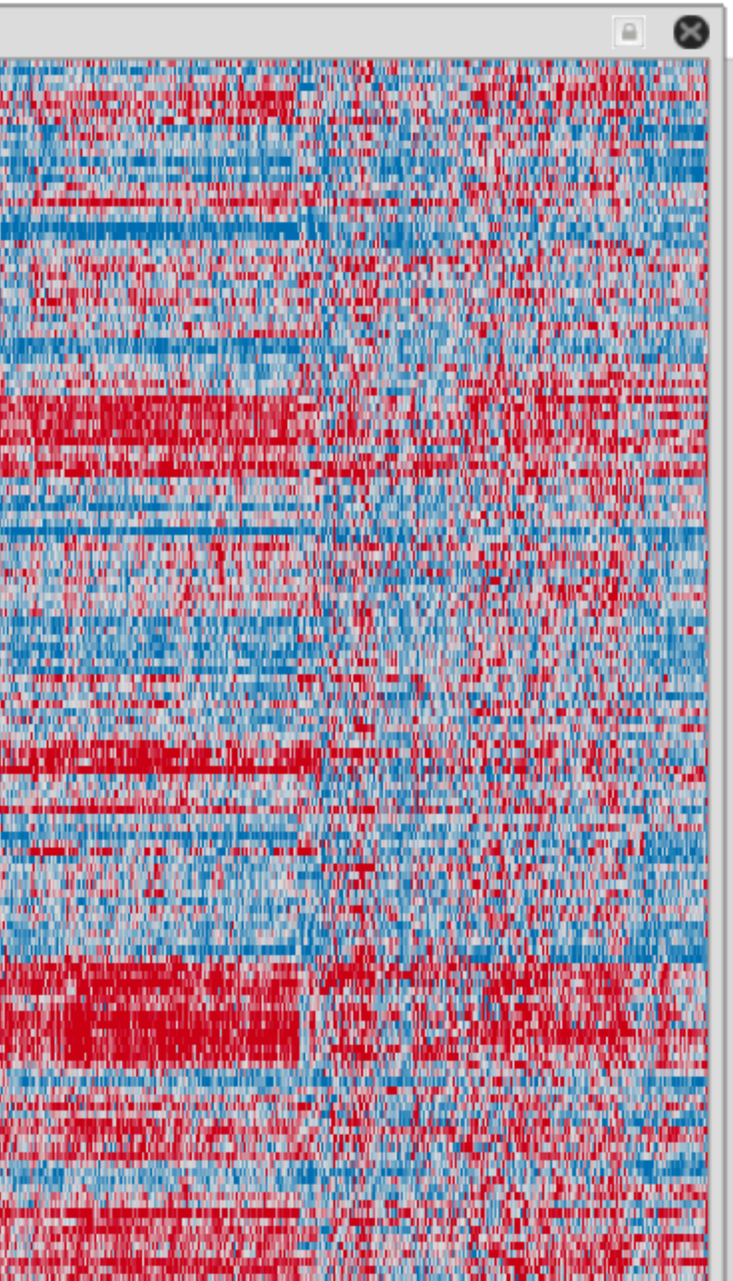
rational

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

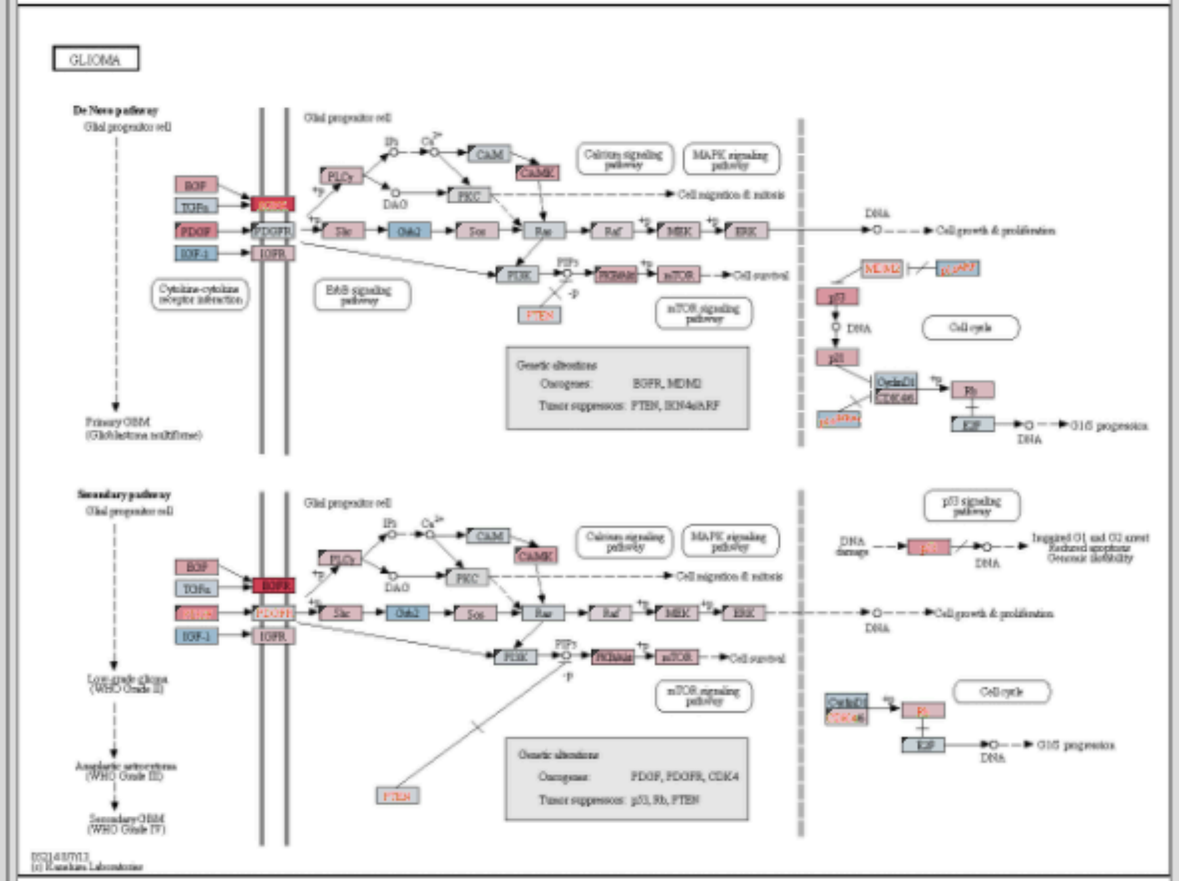
Small Multiples for Graph Attributes

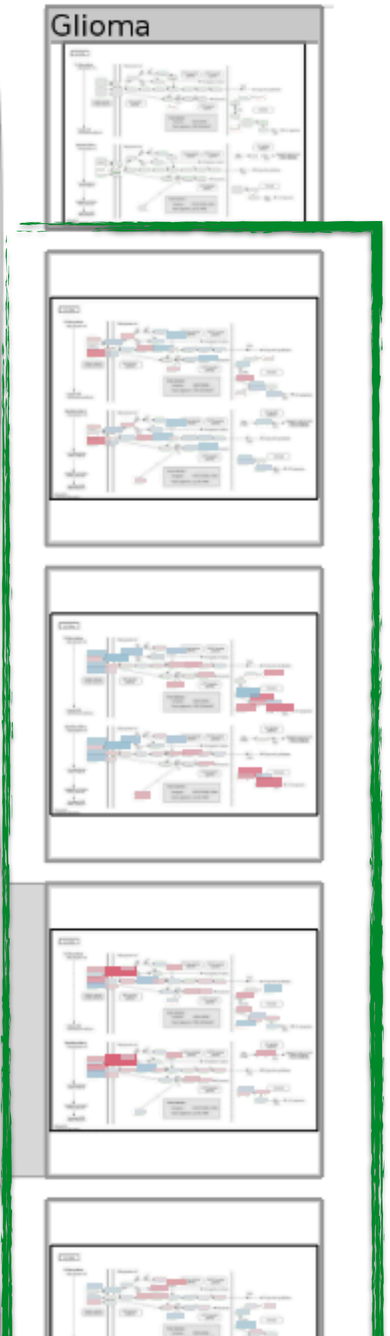
[Barsky, InfoVis 2008]

StratomeX



Glioma





Partitioning

PARTITIONING

action on the dataset that **separates the data into groups**

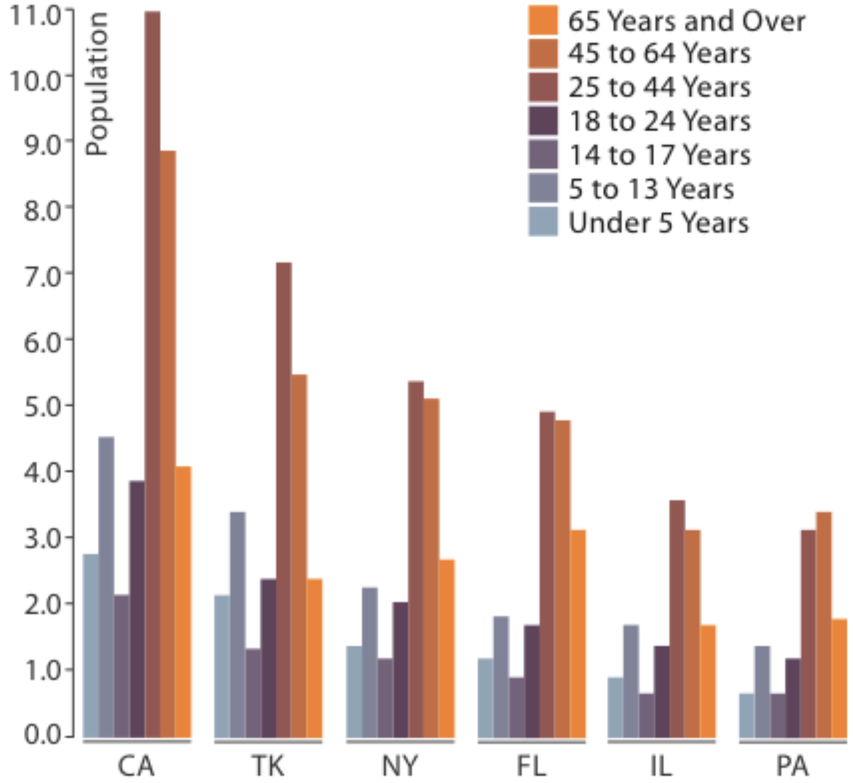
design choices

- 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)

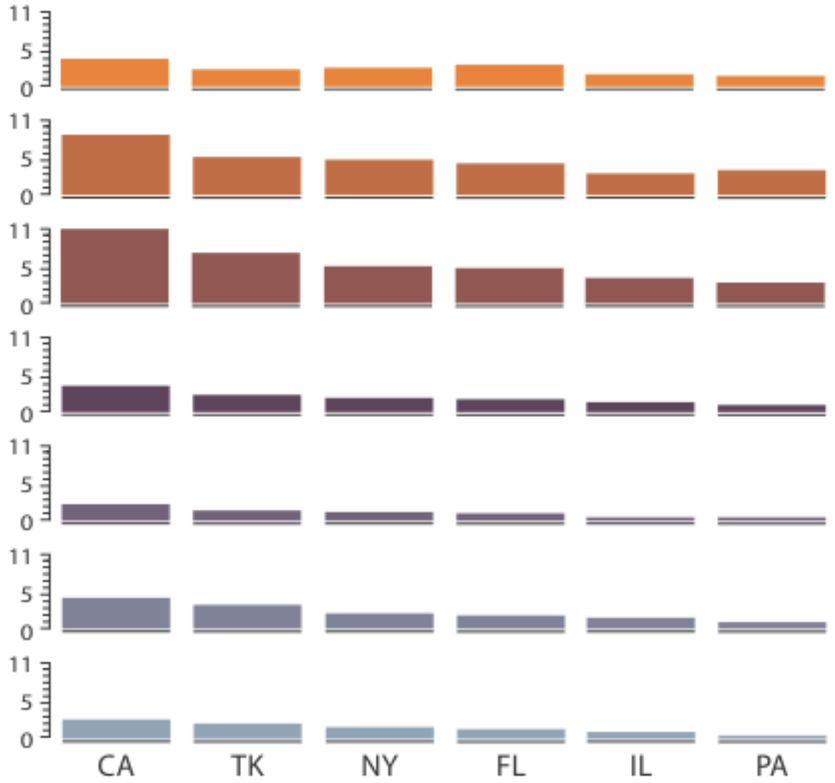
partition attribute(s)

- typically categorical

Partitioning

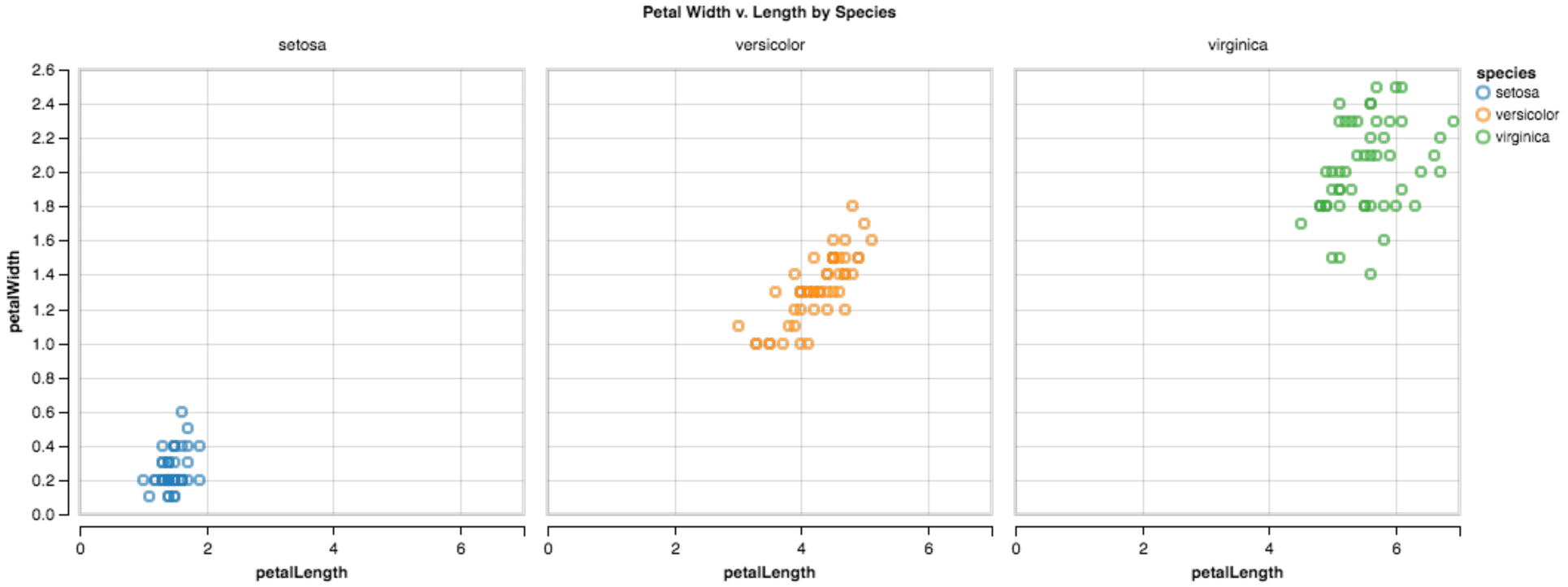


Partitioned by State



Partitioned by Age Group and State

Partition by Category



Trellis Plots

panel variables

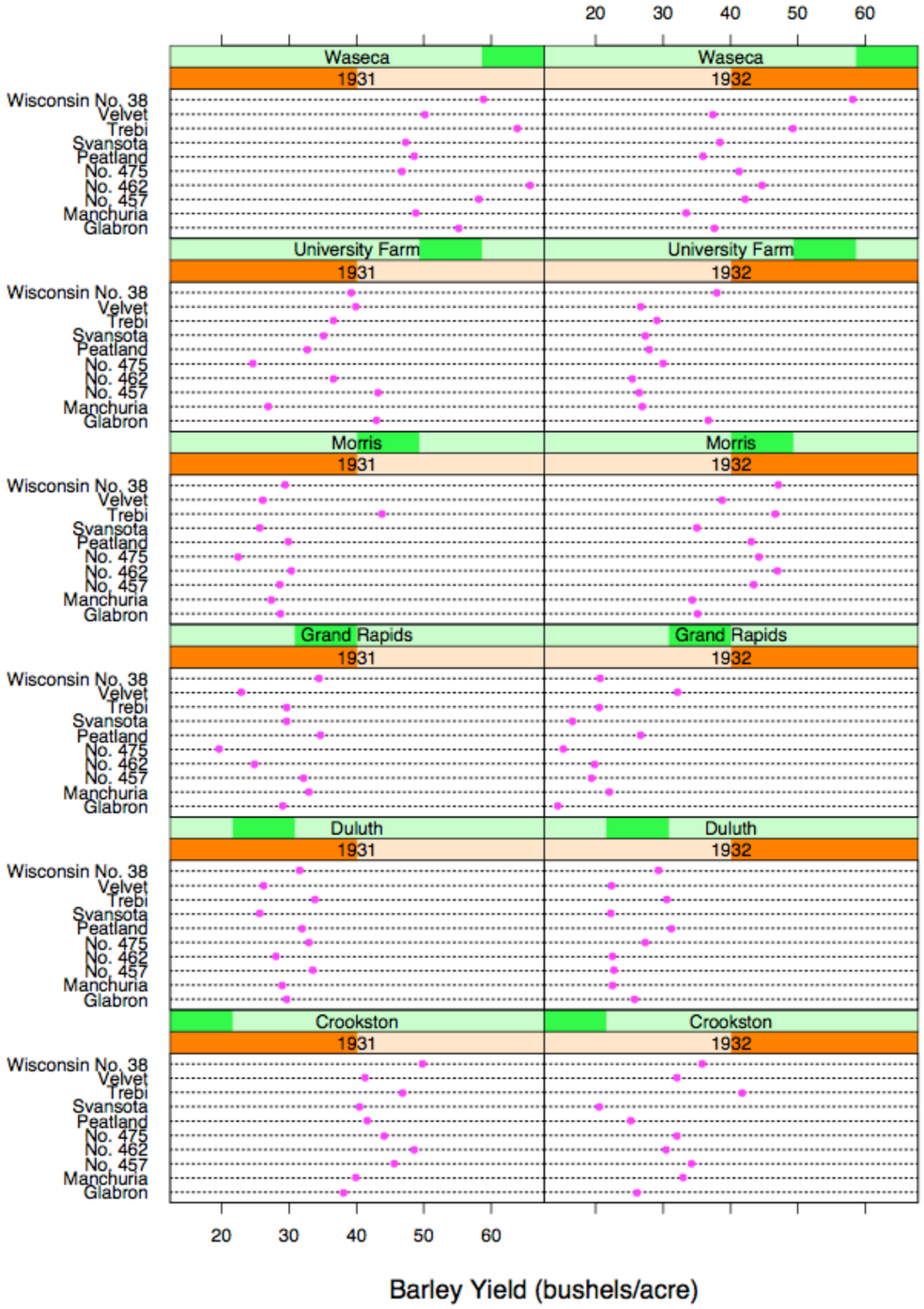
- attributes encoded in individual views

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



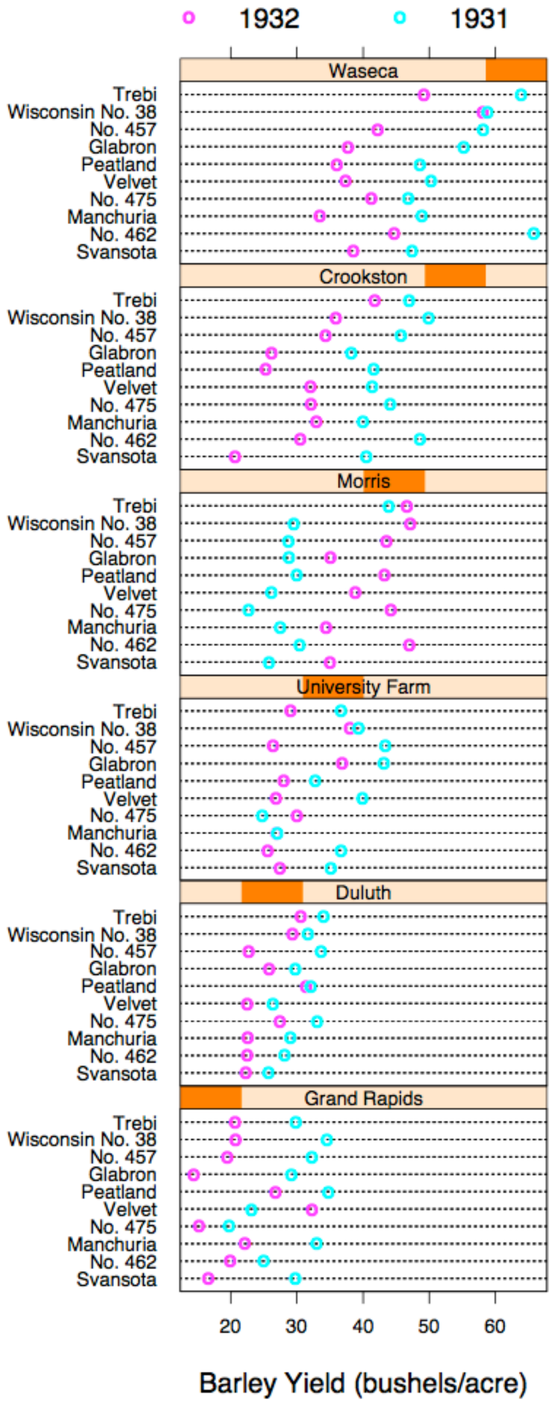
Data

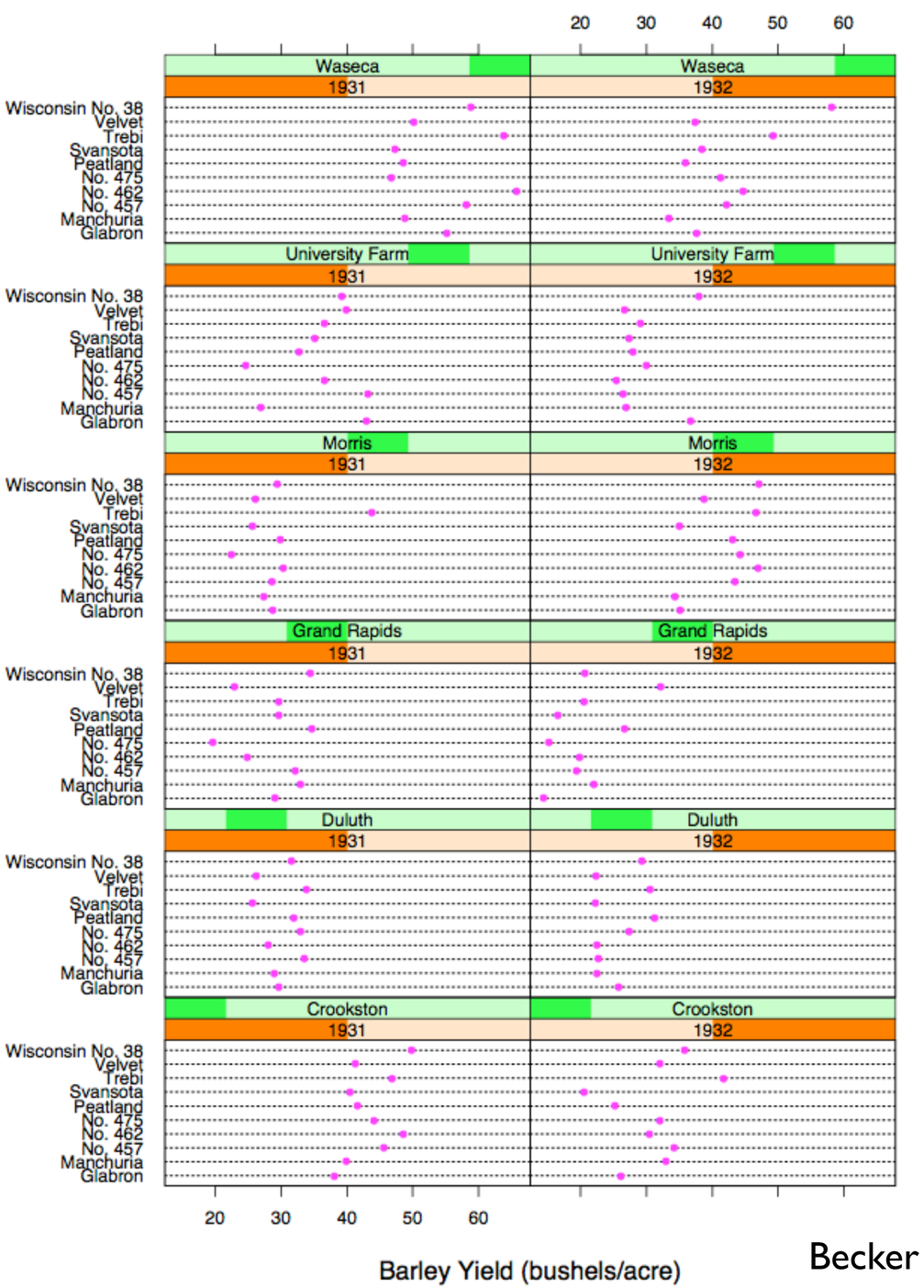
Barley Yields in two years across multiple farms for multiples barley strains

partitioning variables

- Columns partitioned by year
- Rows partitioned by farm

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)

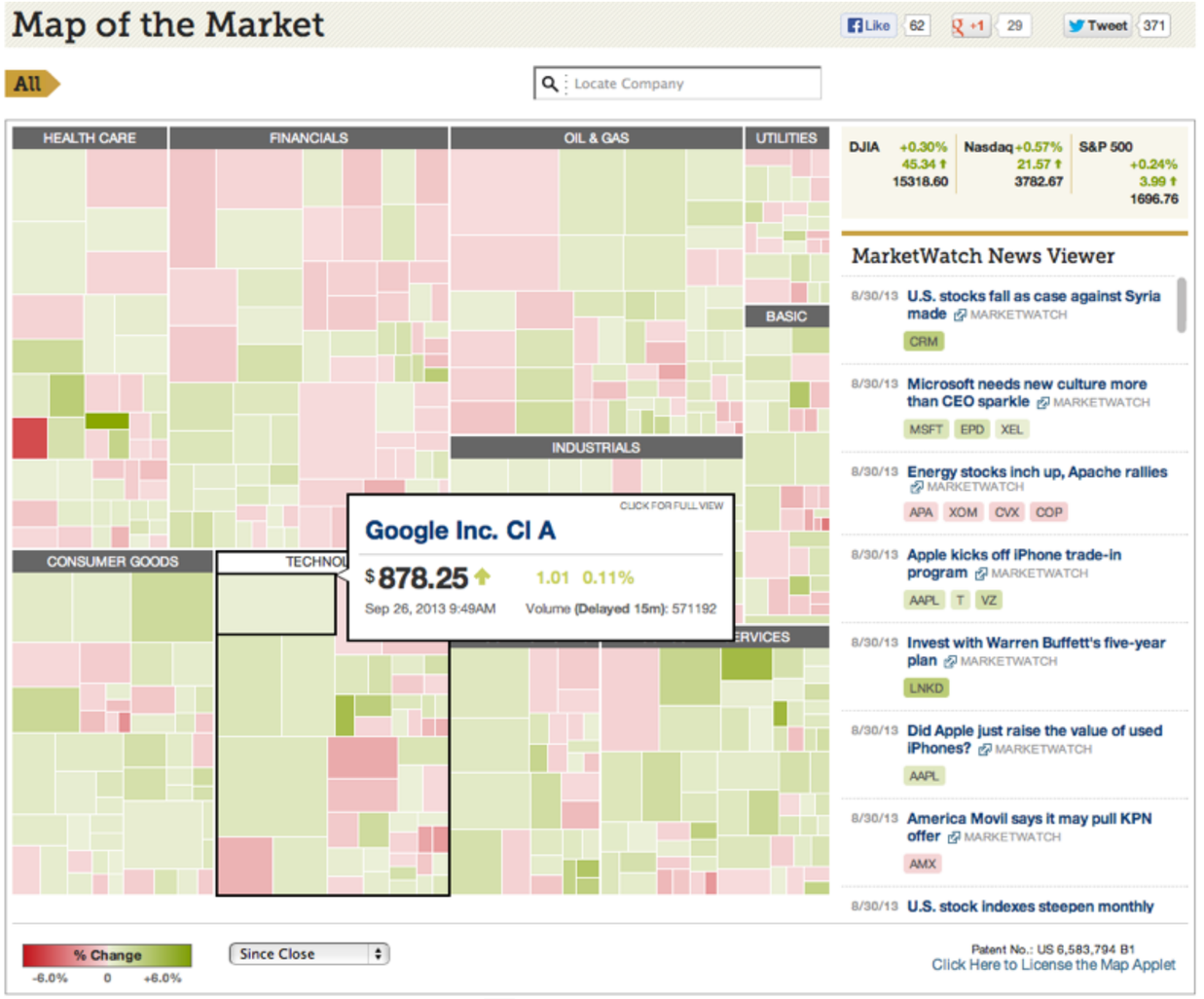

20
30
40
50
60
Waseca
1931
1932
Wisconsin No. 38
Velvet
Trebi
Svansota
Peatland
No. 475
No. 462
No. 457
Manchuria
Glabron
University Farm
Morris
Grand Rapids
Duluth
Crookston
Barley Yield (bushels/acre)

Becker 1996

Recursive Subdivision

partitioning: flexibly transform data attributes into a hierarchy

use treemaps as spacefilling rectangular layouts



Treemap

HiVE example: London property

partitioning attributes

house type
neighborhood
sale time

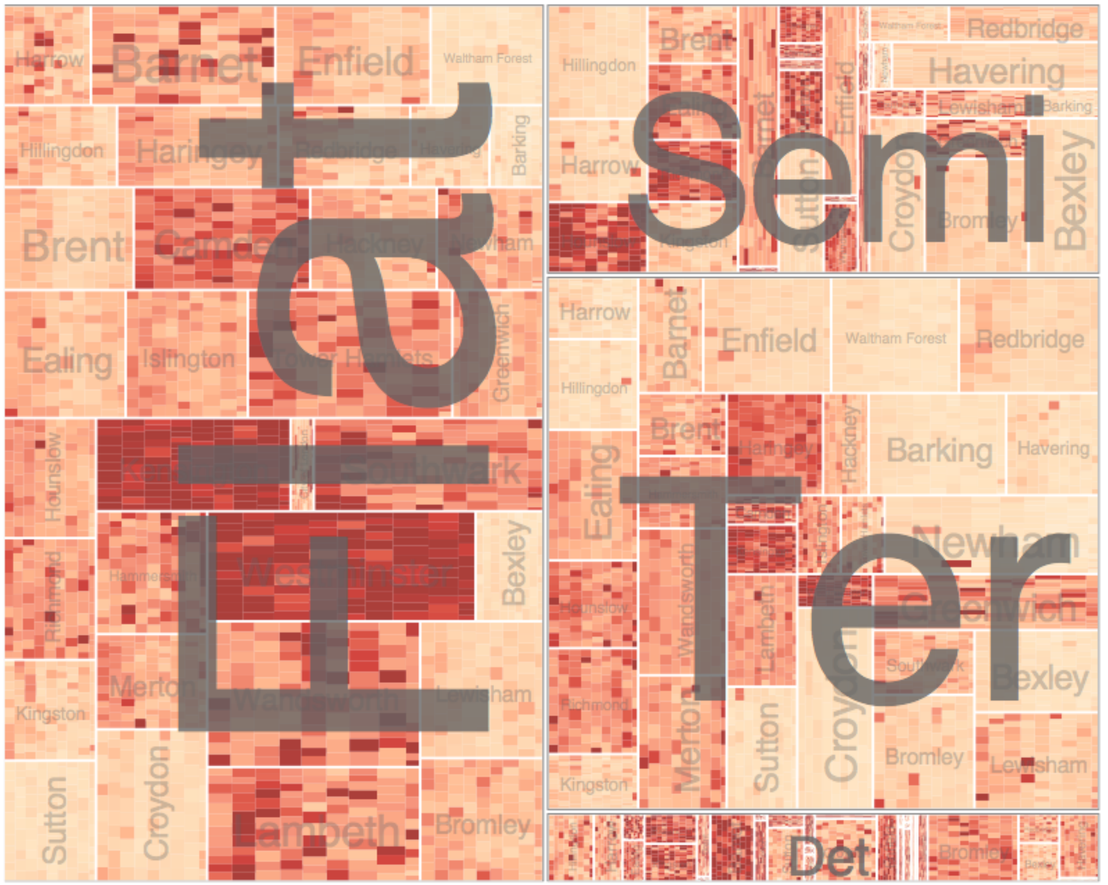
encoding attributes

average price (color)
number of sales (size)

results

between neighborhoods, different housing distributions

within neighborhoods, similar prices



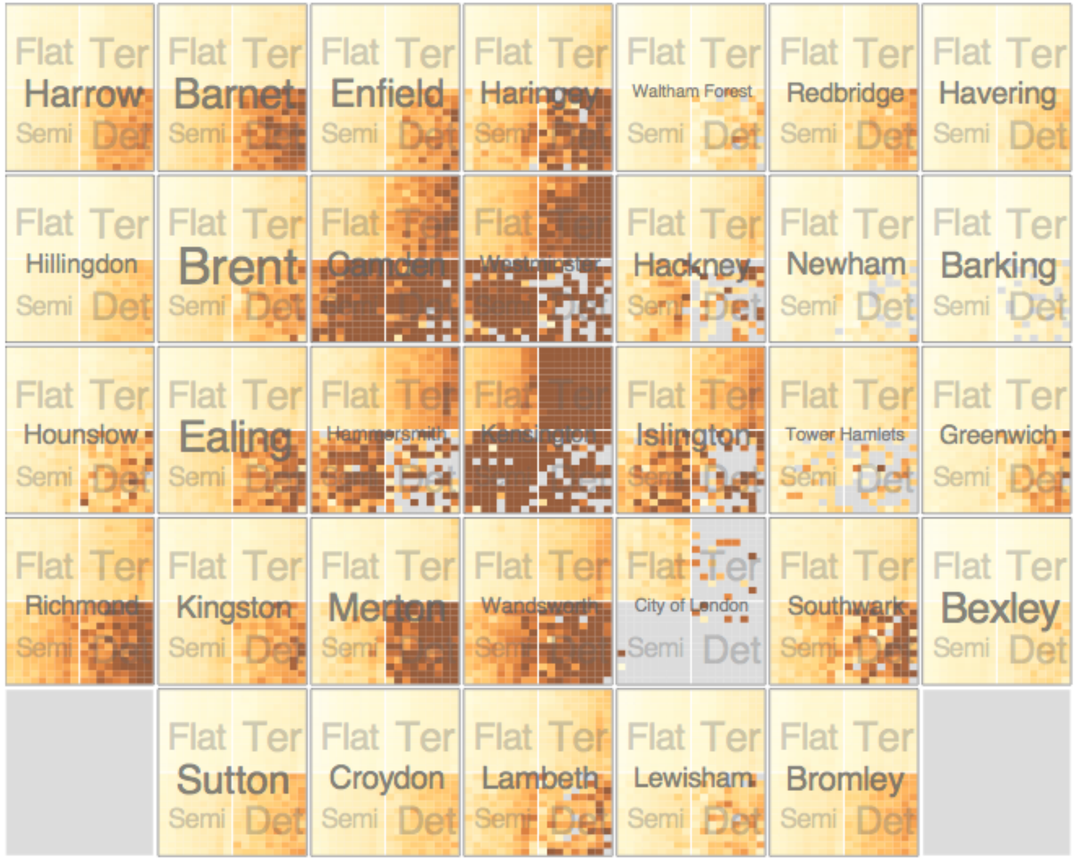
Slingsby 2009

HiVE example: London property

partitioning attributes
neighborhood
house type
sale time (year)
sale time (month)

encoding attributes
neighborhood location (approximate)
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/

https://vimeo.com/9870257

LAYERING

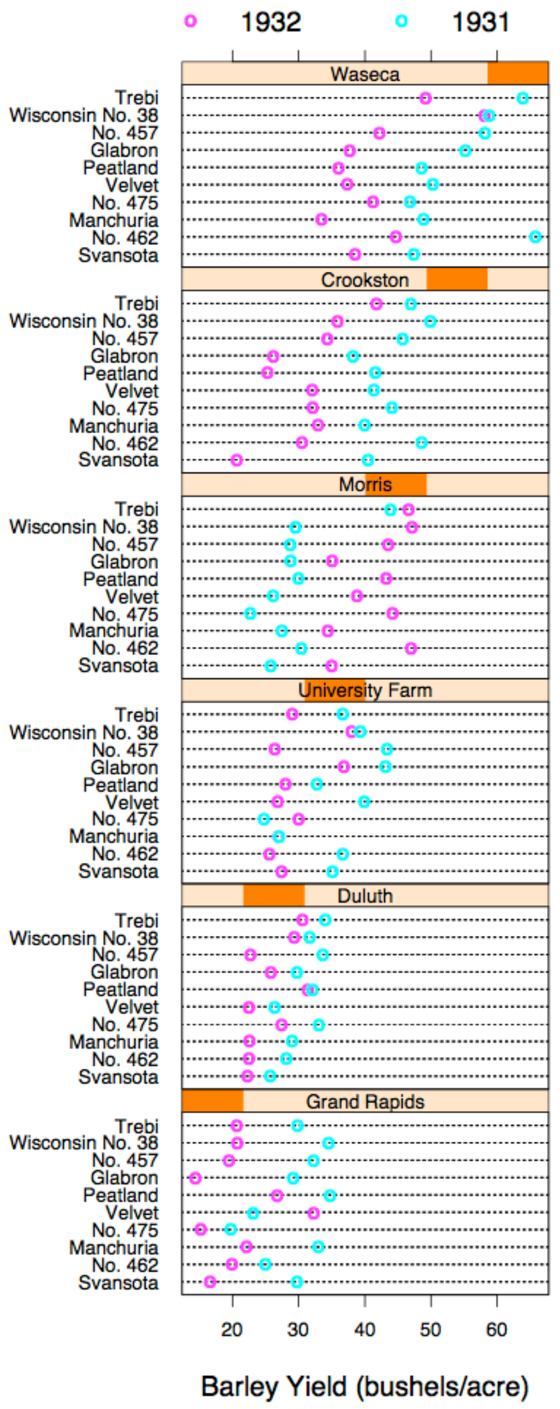
combining multiple views on top of one another to form a composite view

rational

supports a larger, more detailed view than using multiple views

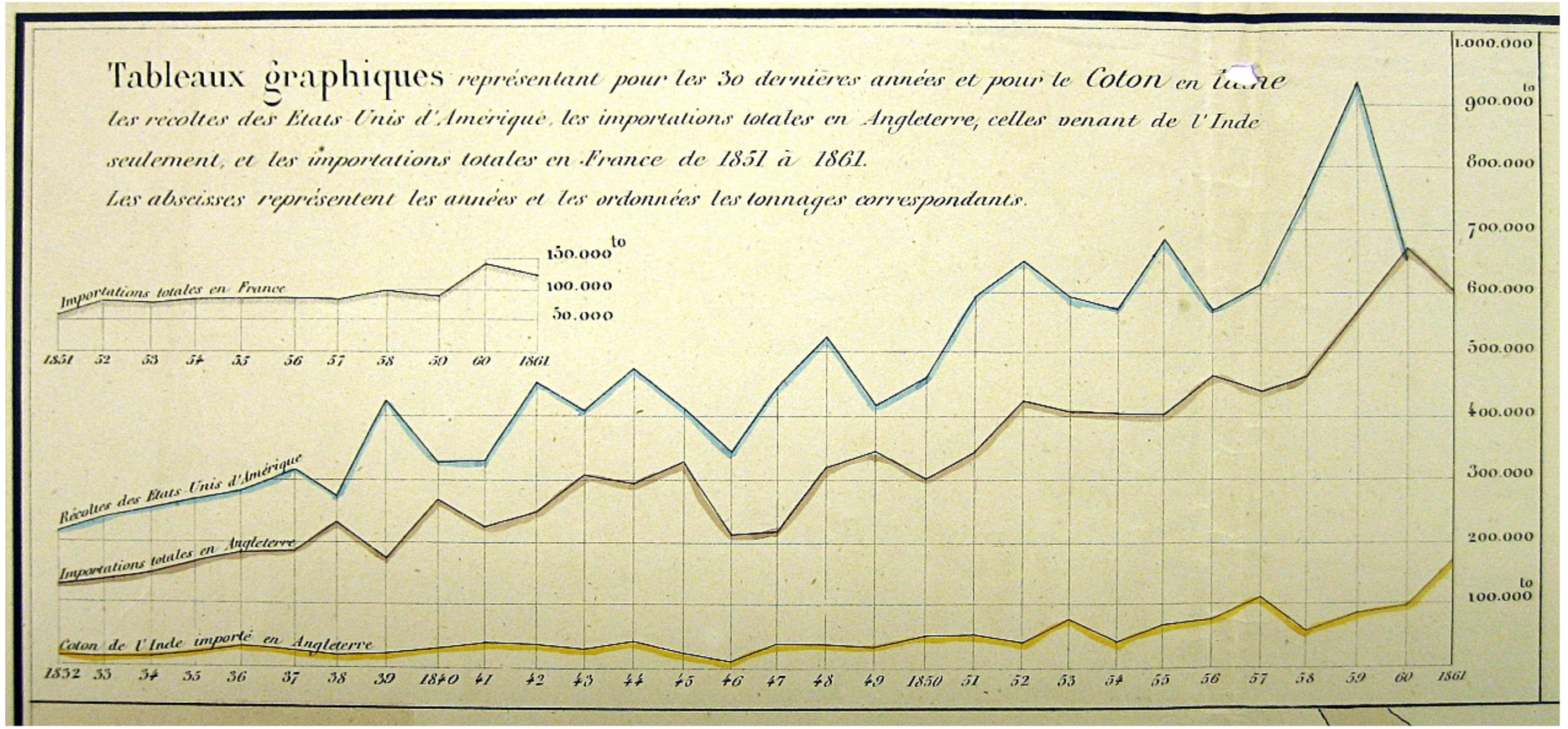
trade-off

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

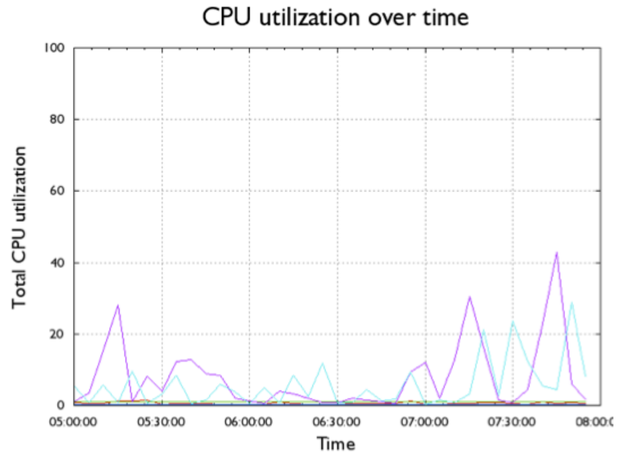


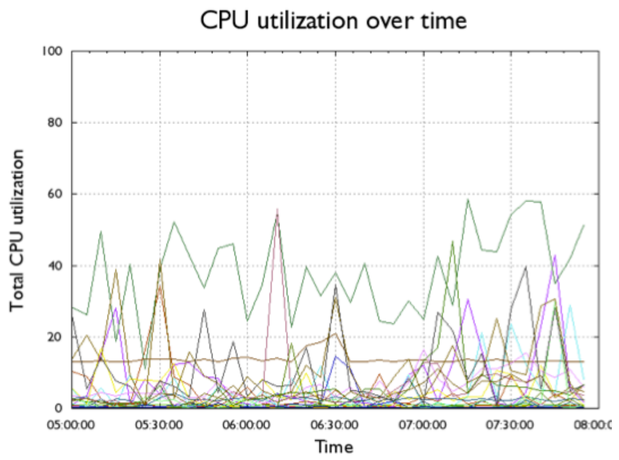
JOSEPH MINARD

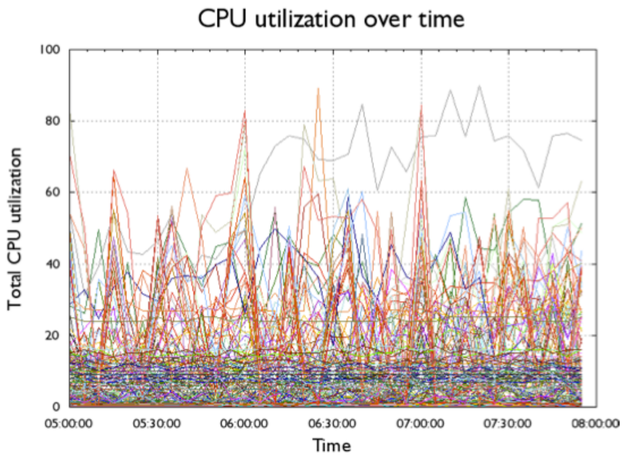
1781-1870



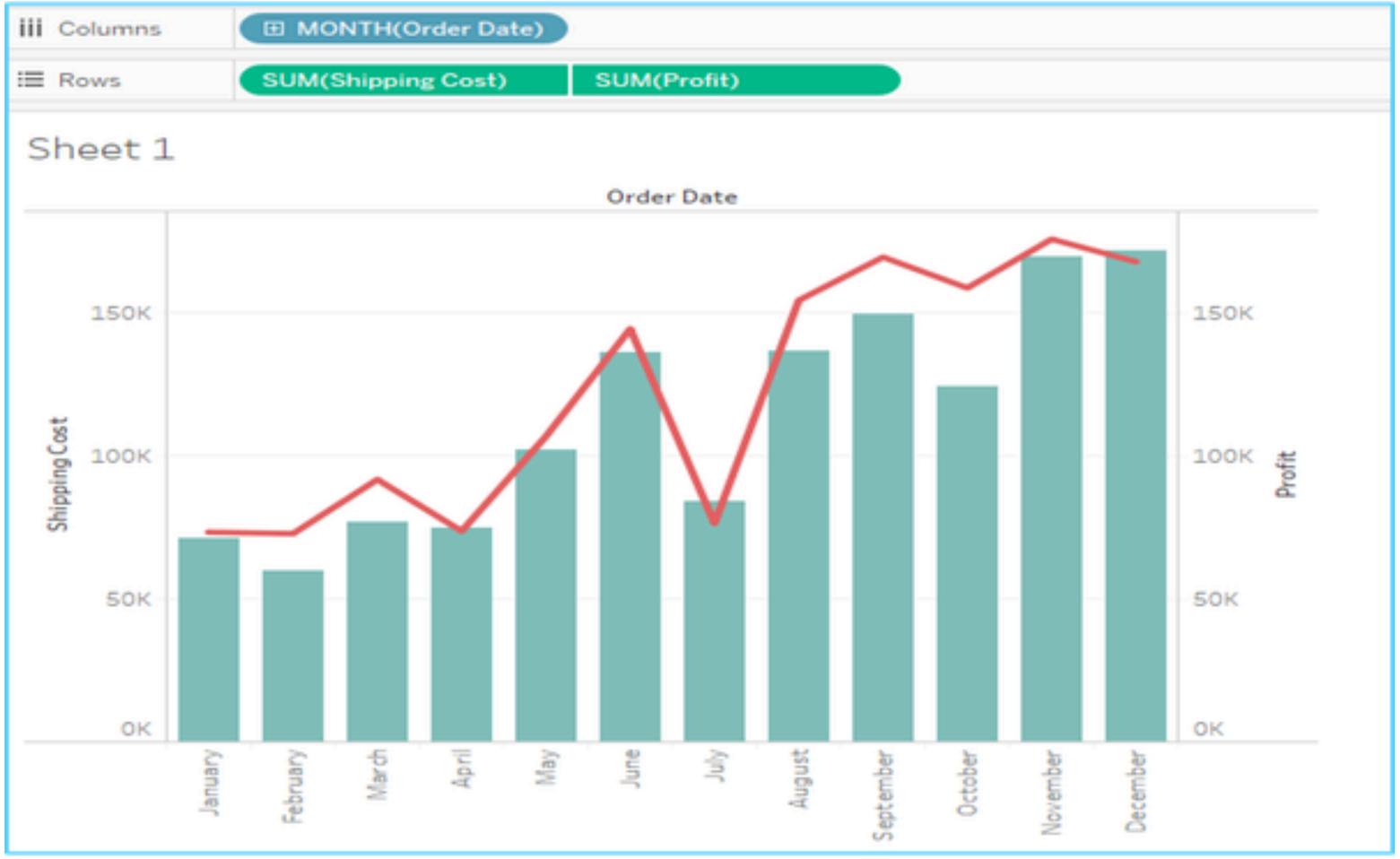
overlays


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

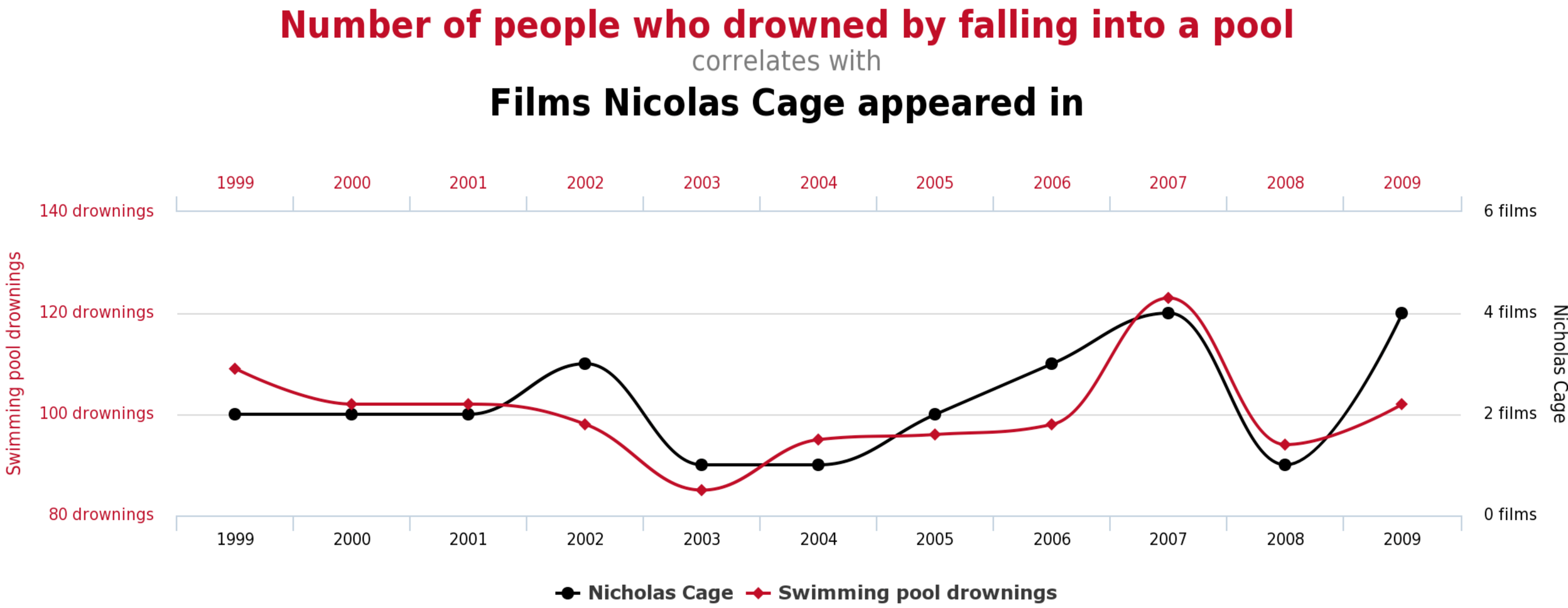

CPU utilization over time
Total CPU utilization
100
80
60
40
20
0
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00
Time


CPU utilization over time
Total CPU utilization
100
80
60
40
20
0
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00
08:00:00
Time

Dual Axis


Columns
MONTH(Order Date)
Rows
SUM(Shipping Cost)
SUM(Profit)
Sheet 1
Order Date
150K
100K
50K
0K
Shipping Cost
150K
100K
50K
0K
Profit
January
February
March
April
May
June
July
August
September
October
November
December

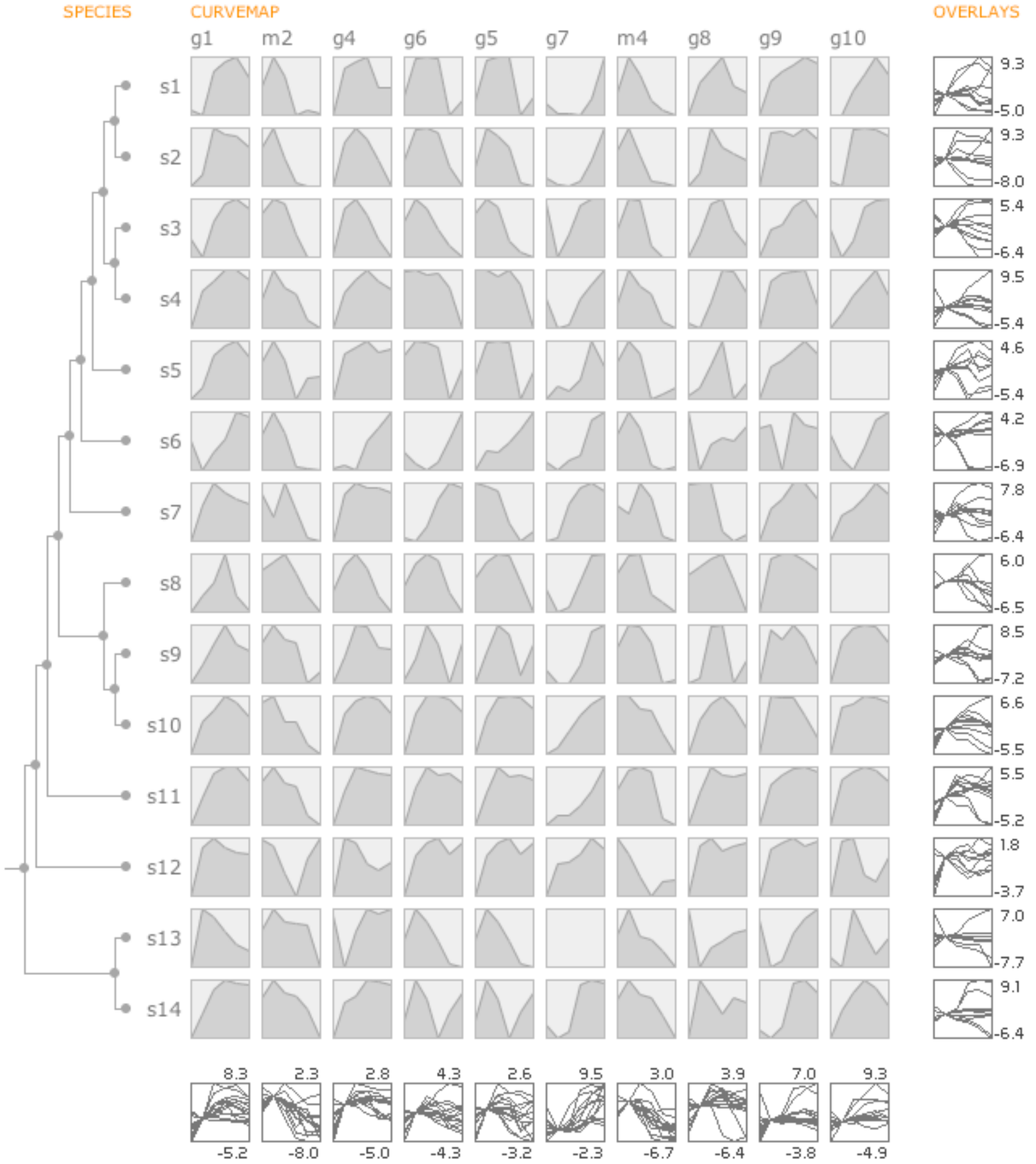
Dual Axis (don't)



Combined

Partitioned + layered graph

Synchronized through highlighting



MCV to the Max