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

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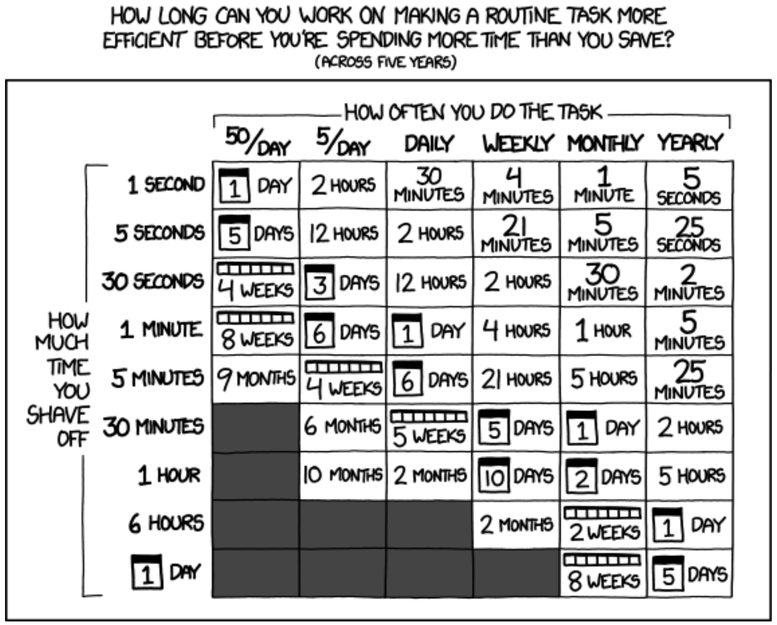
THE UNIVERSITY OF UTAH



[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

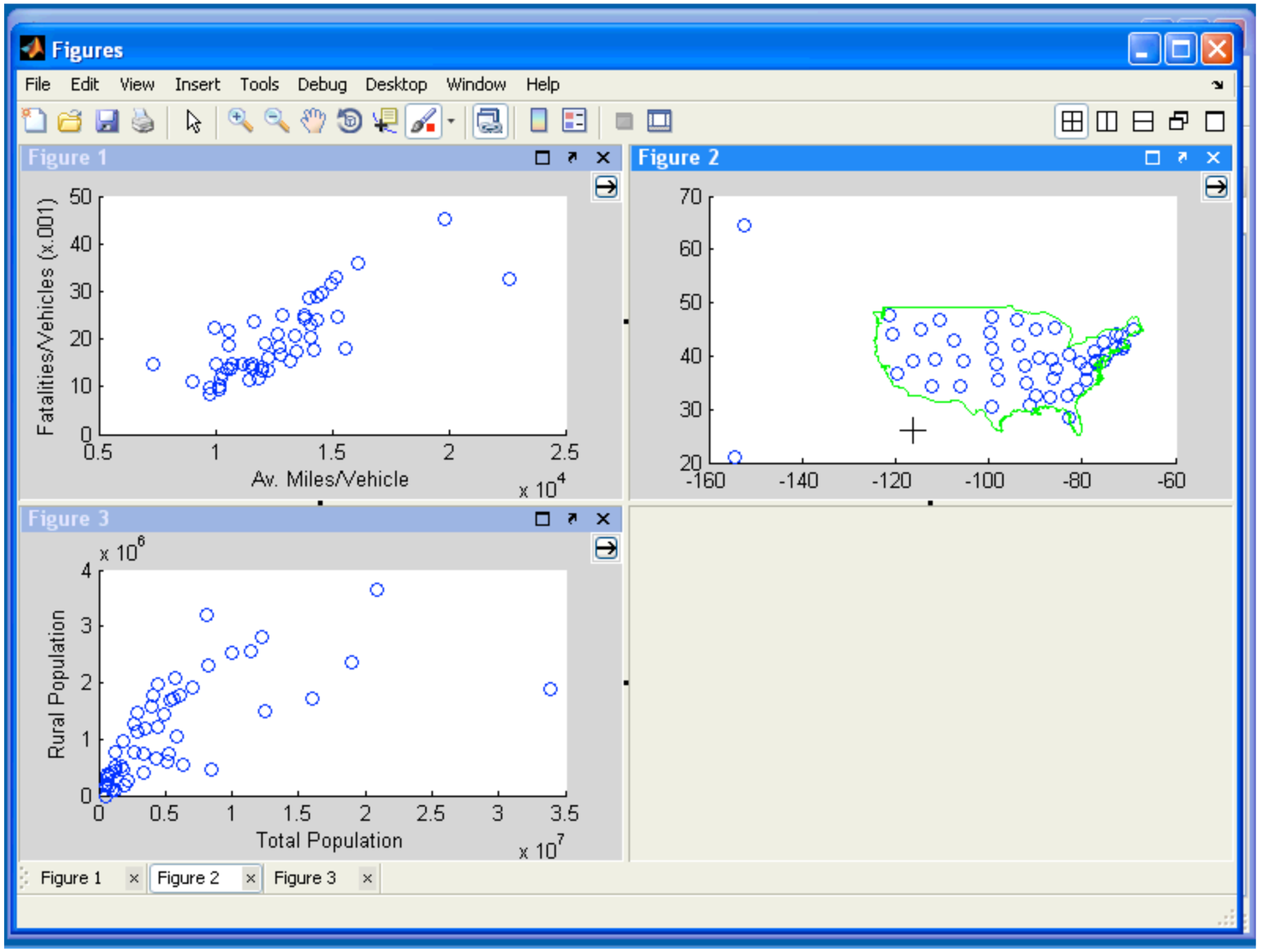
encoding: same or multiform

dataset: share all, subset, or none

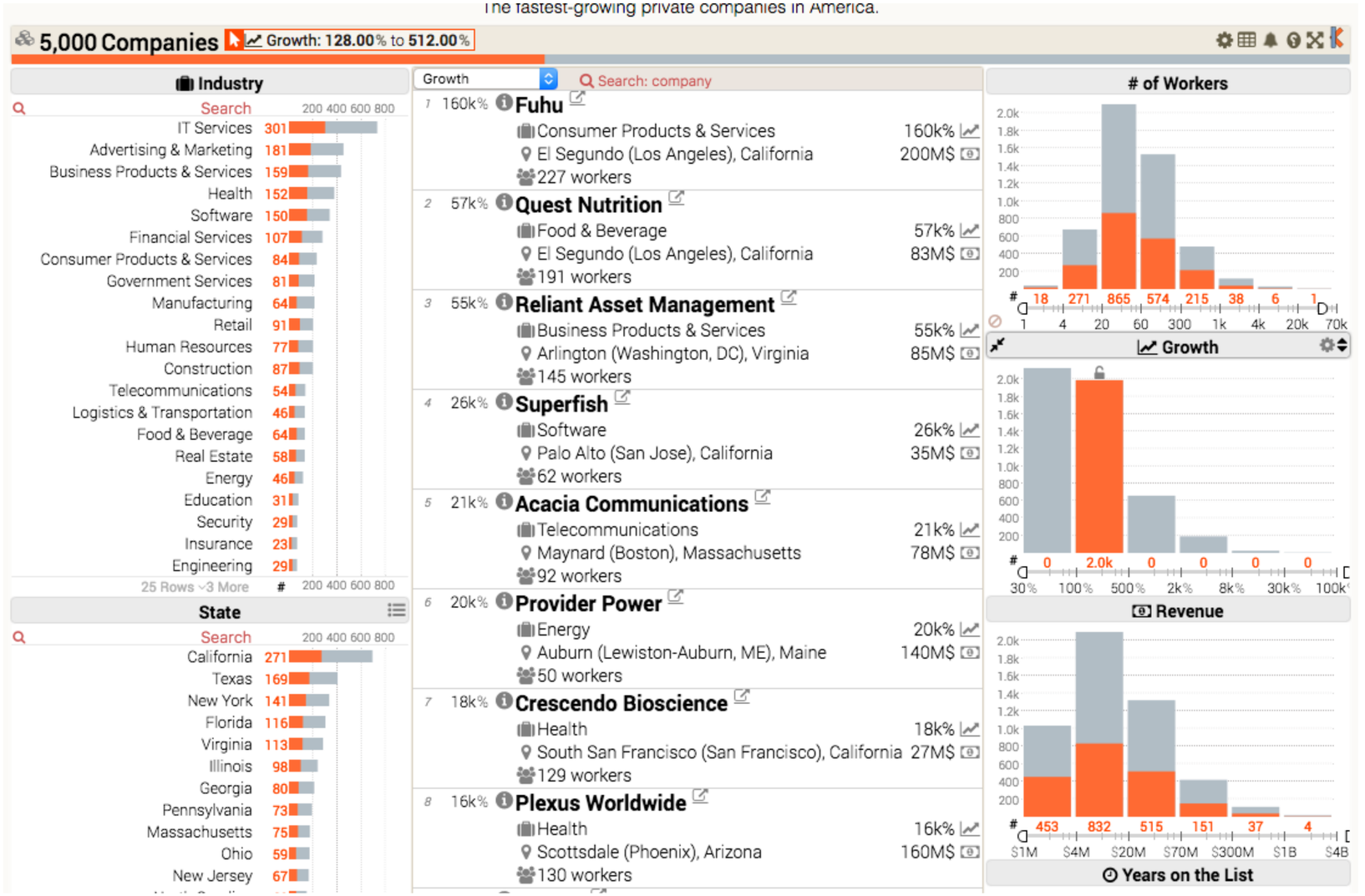
highlighting: to link, or not

navigation: to share, or not

Linked Highlighting



Linked Highlighting

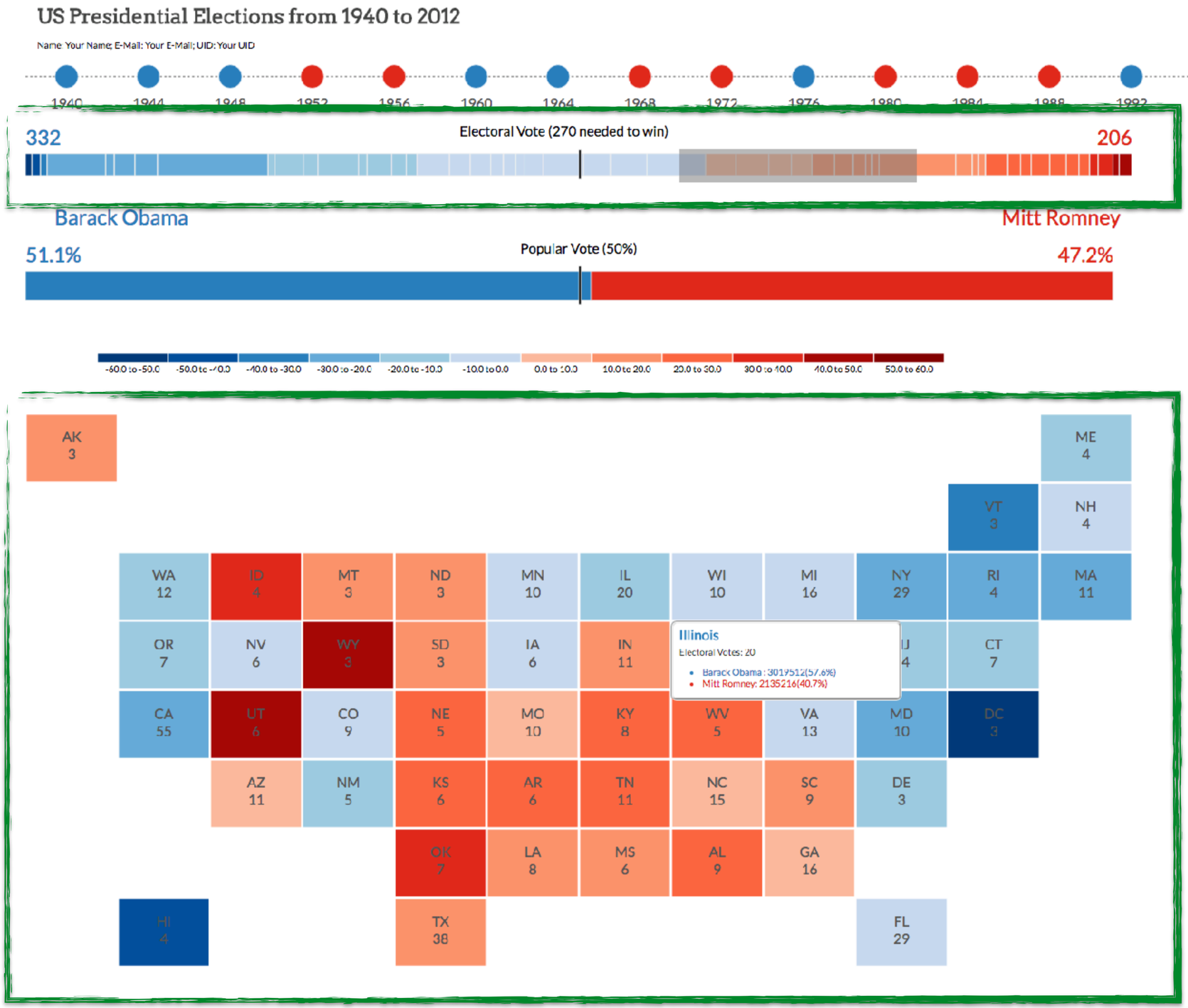


Multiform

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



Brush selection is:

- North Carolina
- Georgia
- Arizona
- Missouri
- Indiana
- South Carolina
- Mississippi
- Montana
- Alaska

Multiform
Different Views
here also same data

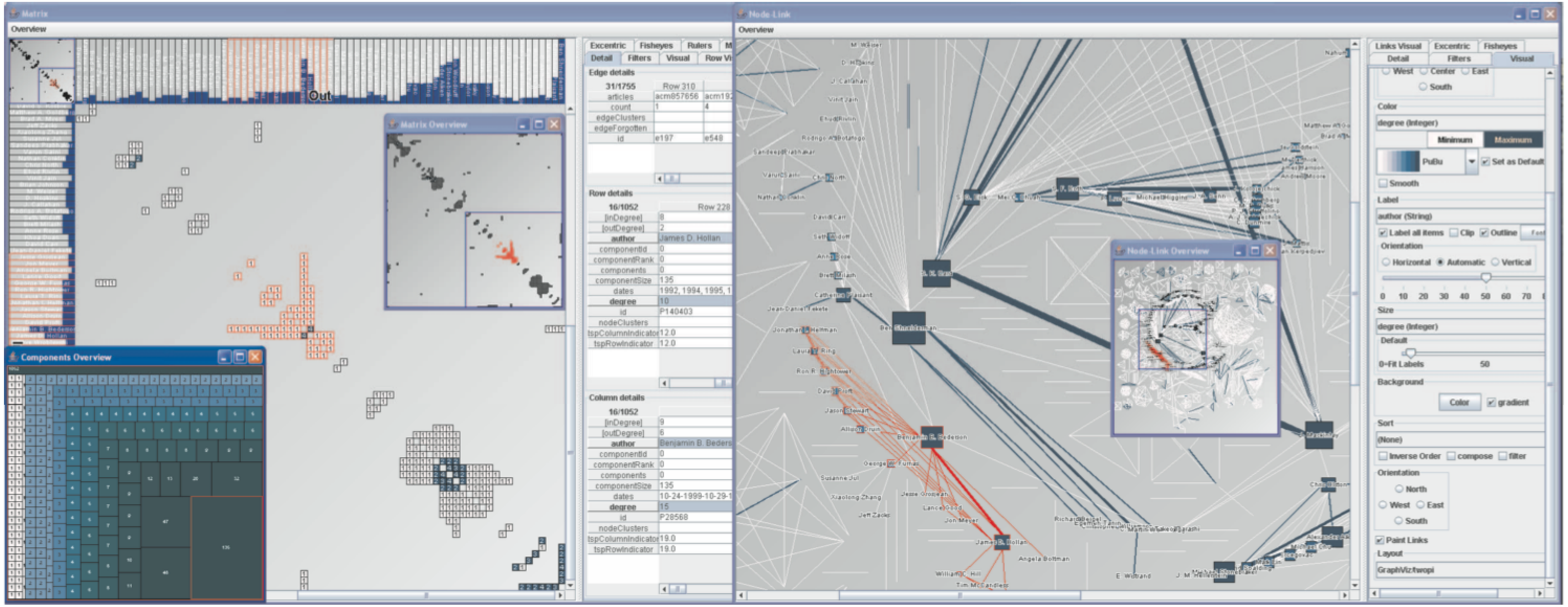
SHARED-DATA

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

rational

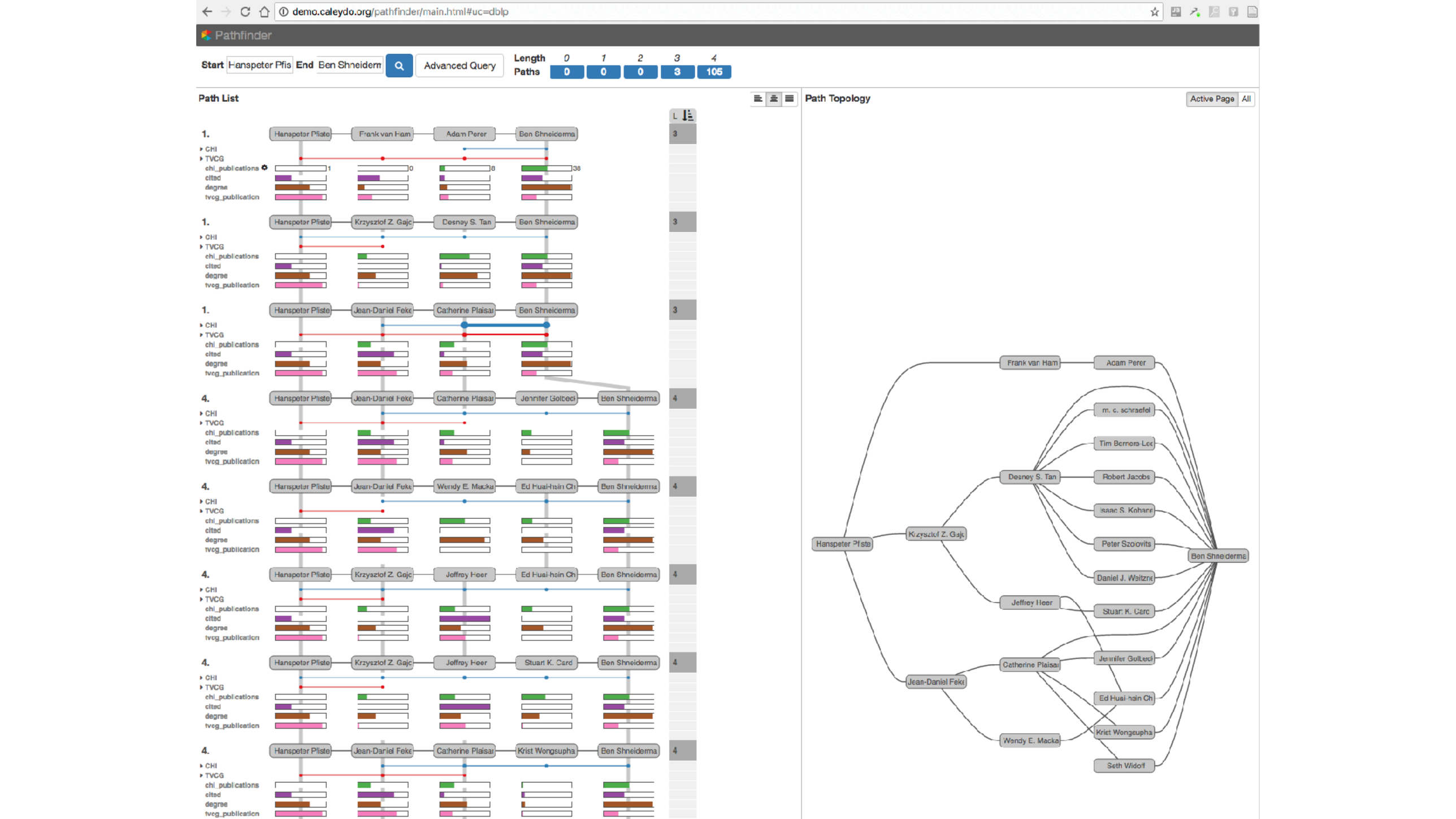
different views support different tasks

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
Path Topology
Active Page All
1.
Hanspeter Pfiste
Frank van Ham
Adam Perer
Ben Shneiderma
3
1.
Hanspeter Pfiste
Krzysztof Z. Gajc
Desney S. Tan
Ben Shneiderma
3
1.
Hanspeter Pfiste
Jean-Daniel Feke
Catherine Plaisar
Ben Shneiderma
3
4.
Hanspeter Pfiste
Jean-Daniel Feke
Catherine Plaisar
Jennifer Golbeck
Ben Shneiderma
4
4.
Hanspeter Pfiste
Jean-Daniel Feke
Wendy E. Macka
Ed Huai-hsin Ch
Ben Shneiderma
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4.
Hanspeter Pfiste
Krzysztof Z. Gajc
Jeffrey Heer
Ed Huai-hsin Ch
Ben Shneiderma
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Hanspeter Pfiste
Krzysztof Z. Gajc
Jeffrey Heer
Stuart K. Card
Ben Shneiderma
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Jean-Daniel Feke
Catherine Plaisar
Krist Wongsupha
Ben Shneiderma
4
CHI
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Frank van Ham
Adam Perer
m. c. schraefel
Tim Berners-Lee
Desney S. Tan
Robert Jacobs
Isaac S. Kohane
Peter Szolovits
Daniel J. Weitzne
Hanspeter Pfiste
Krzysztof Z. Gajc
Ben Shneiderma
Jeffrey Heer
Stuart K. Card
Jennifer Golbeck
Catherine Plaisar
Jean-Daniel Feke
Ed Huai-hsin Ch
Krist Wongsupha
Wendy E. Macka
Seth Widoff

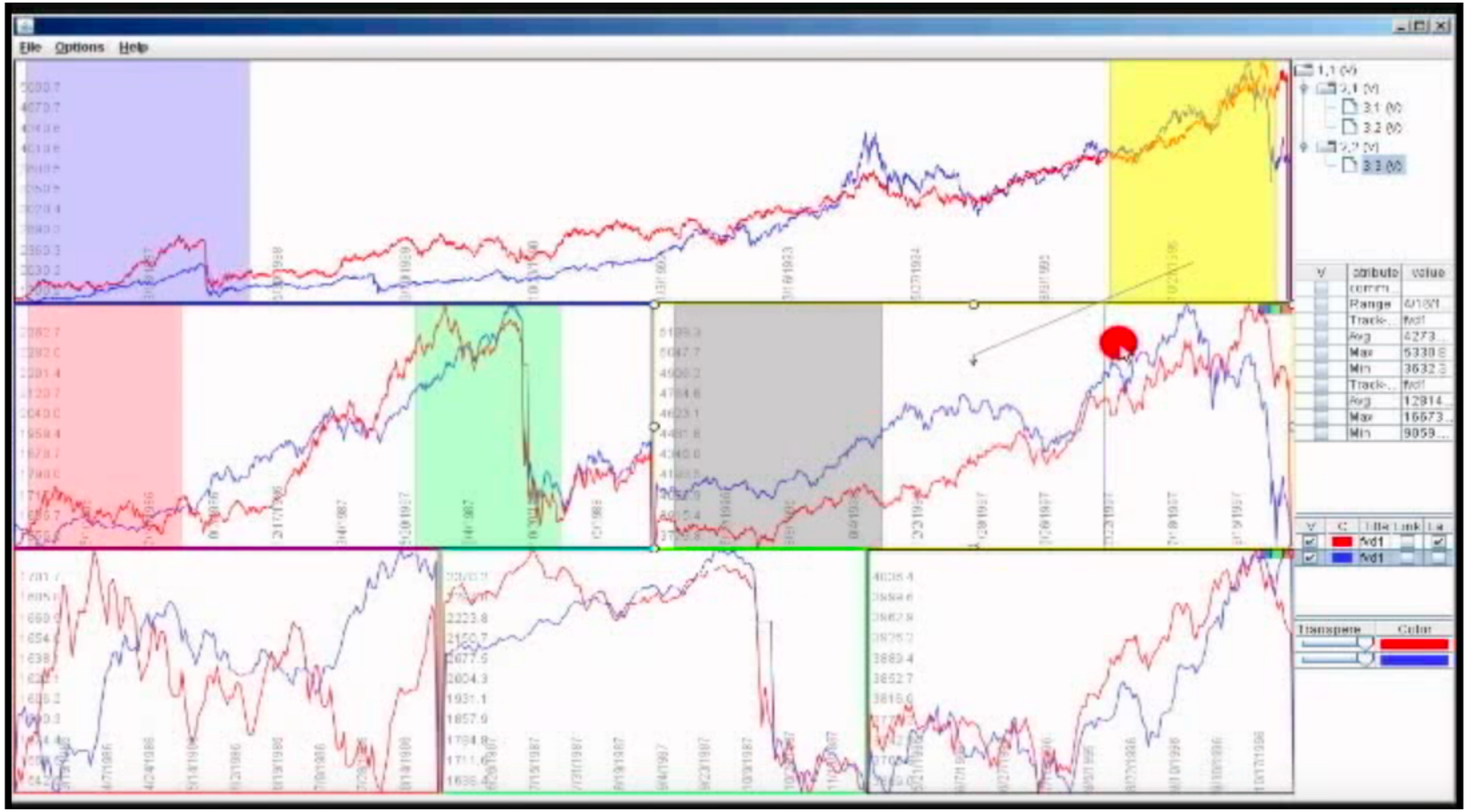
OVERVIEW + DETAIL

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

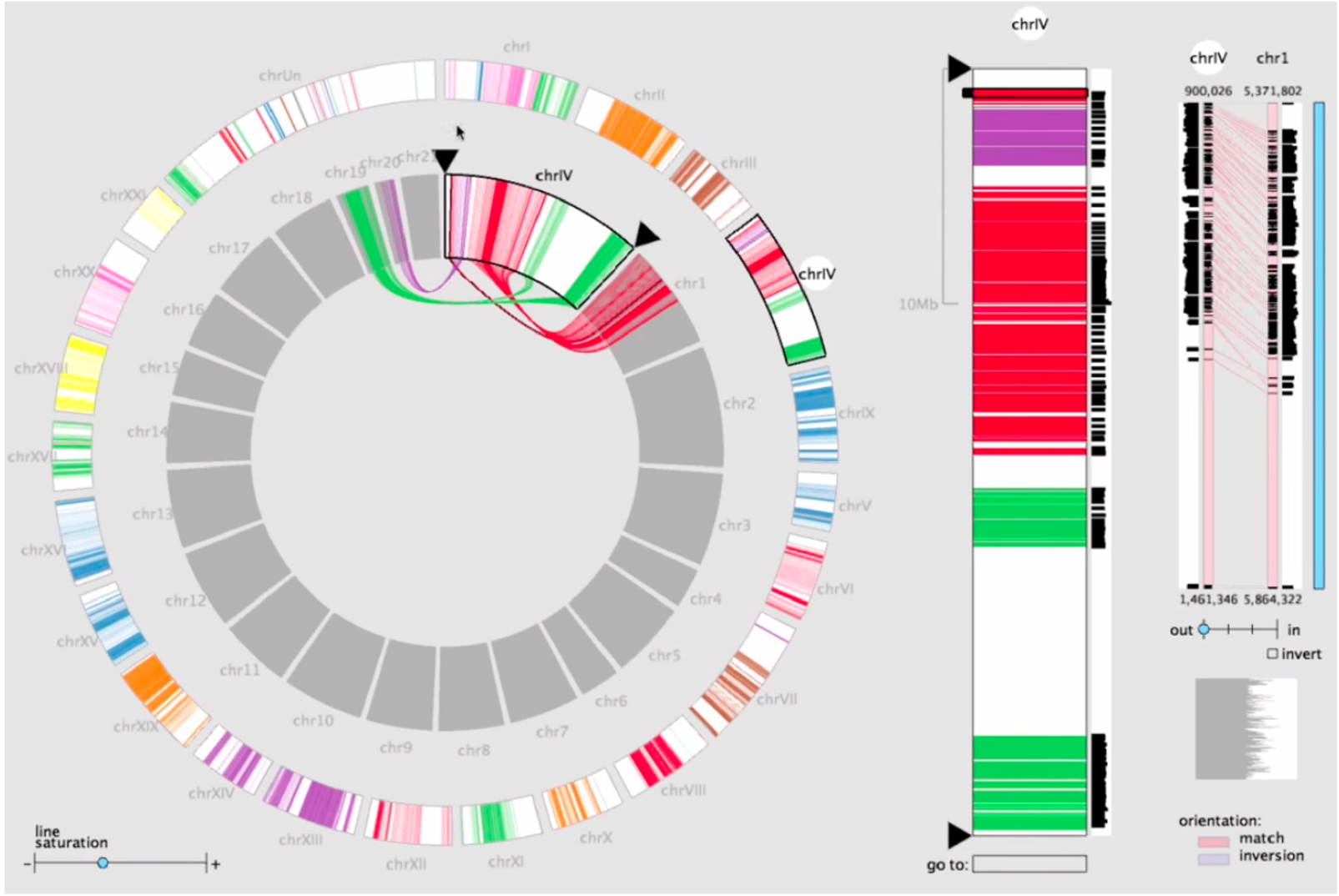
Stack Zooming



Same Data - Same Encoding, Different Resolution

[Javed & Emlqvist, PacificVis, 2010]

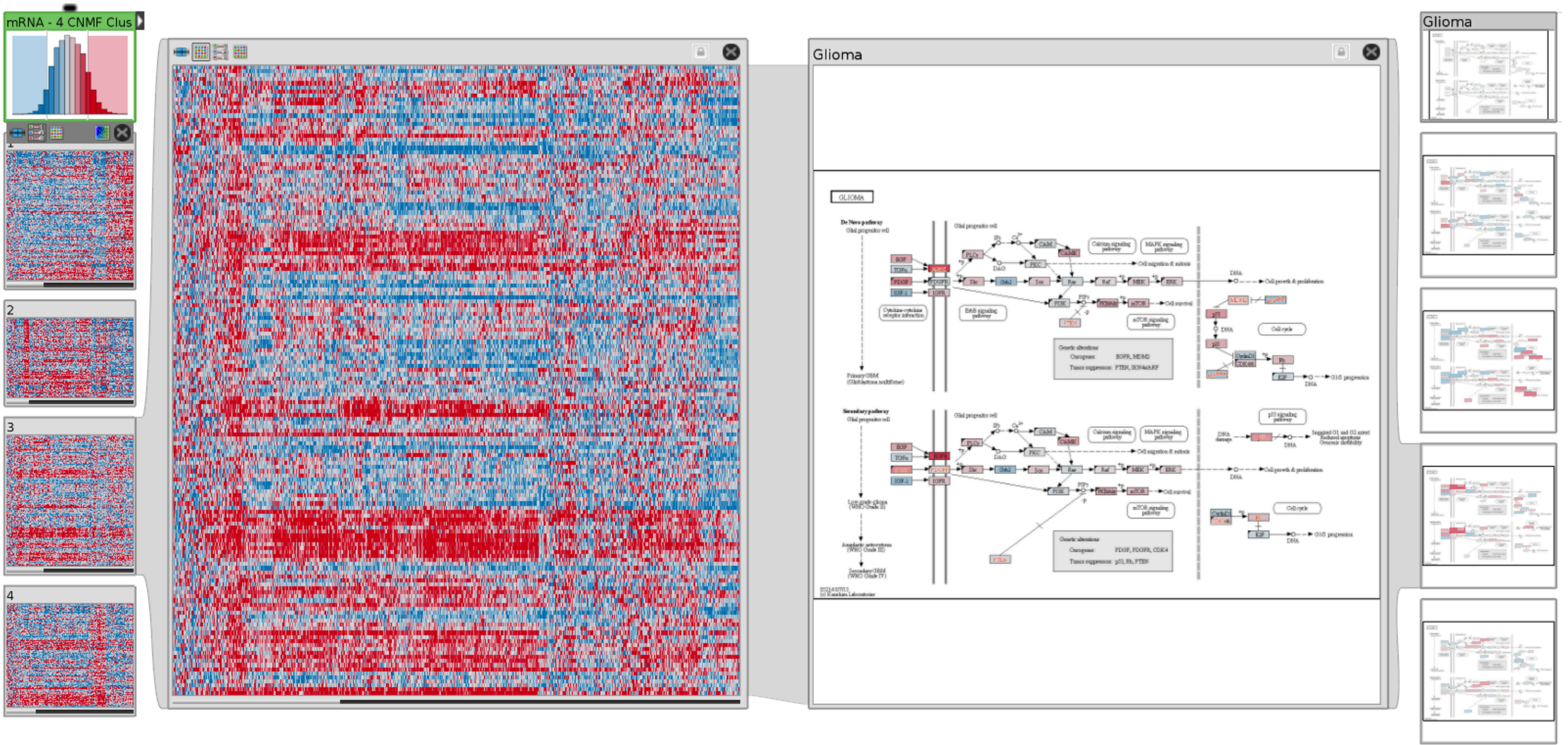
MizBee



Multiform Overview & Detail

[Meyer 2009]

StratomeX



SMALL MULTIPLES

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

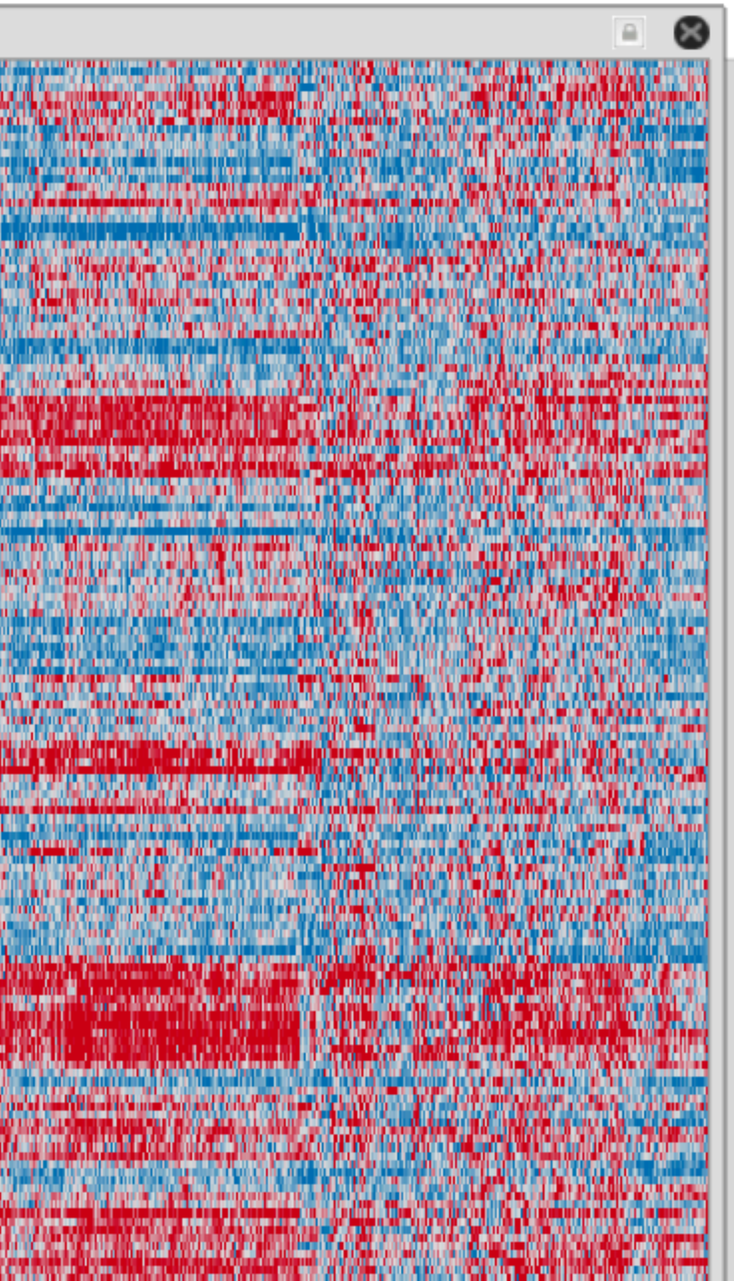
rational

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

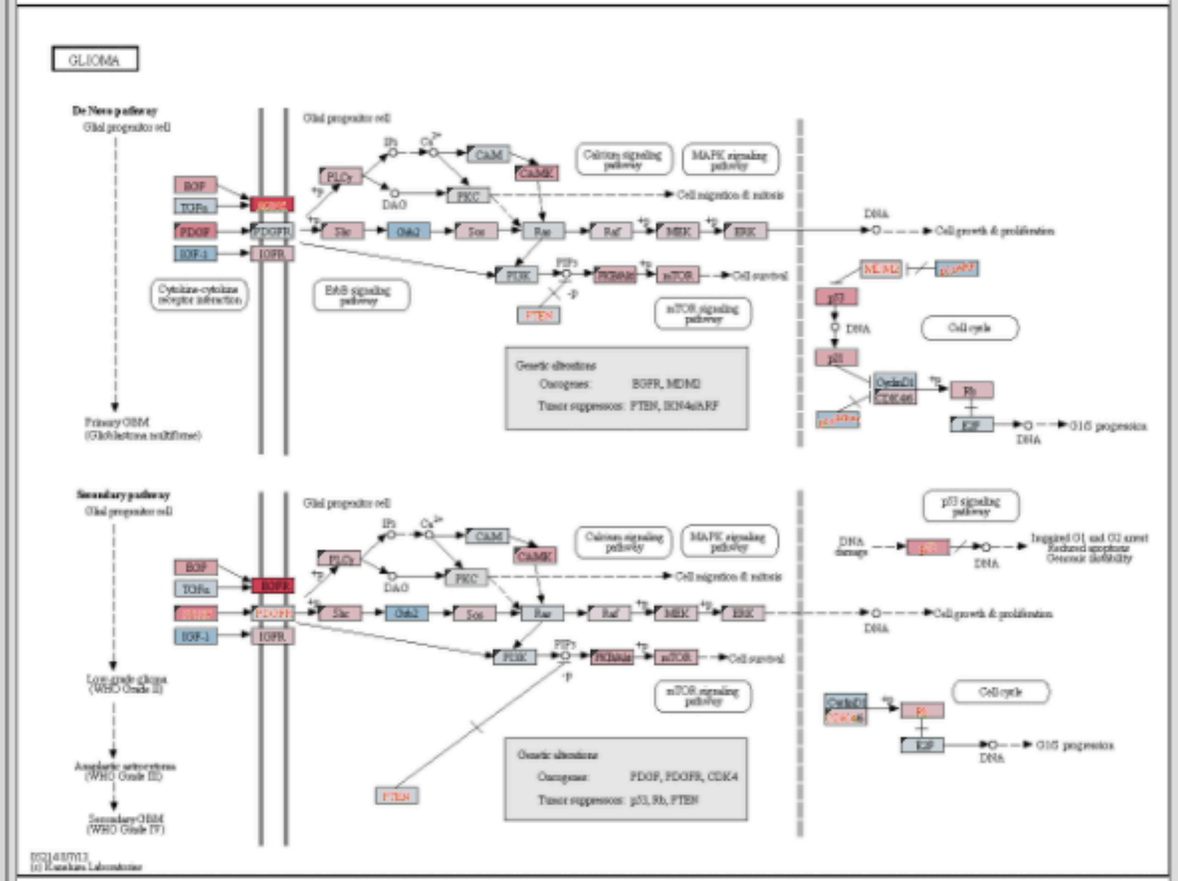
Small Multiples for Graph Attributes

[Barsky, InfoVis 2008]

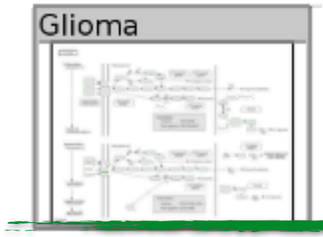
StratomeX

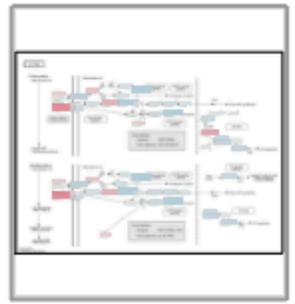


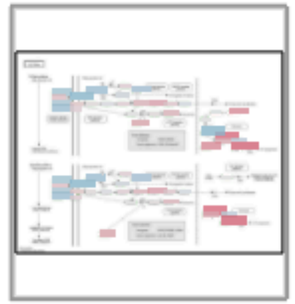
Glioma

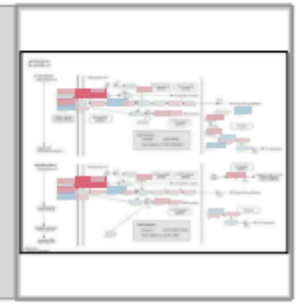


Glioma









Partitioning

PARTITIONING

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

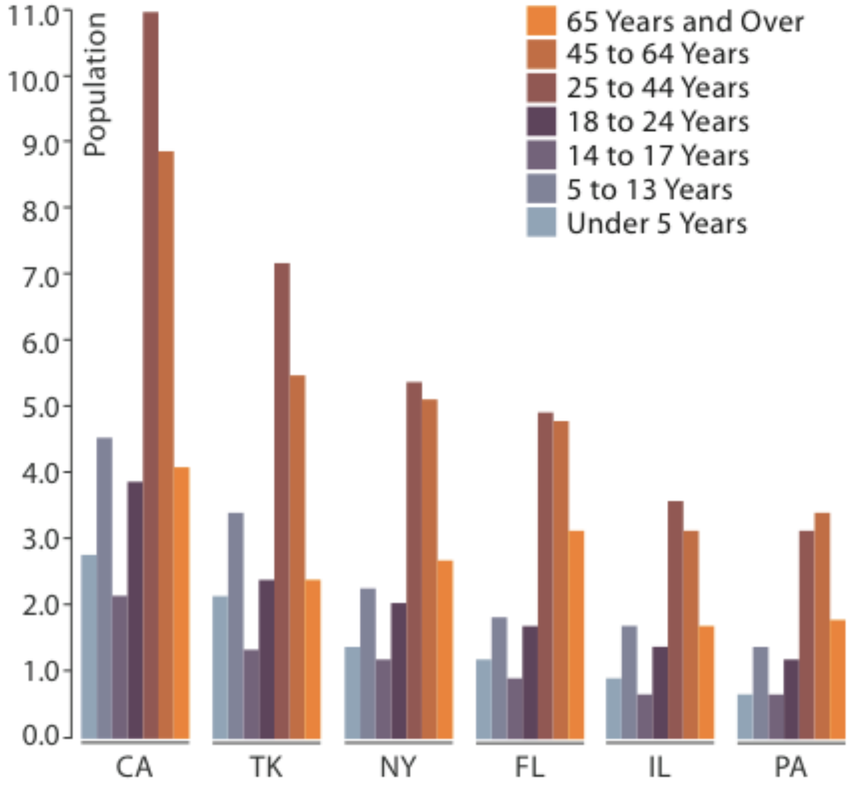
design choices

- 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)

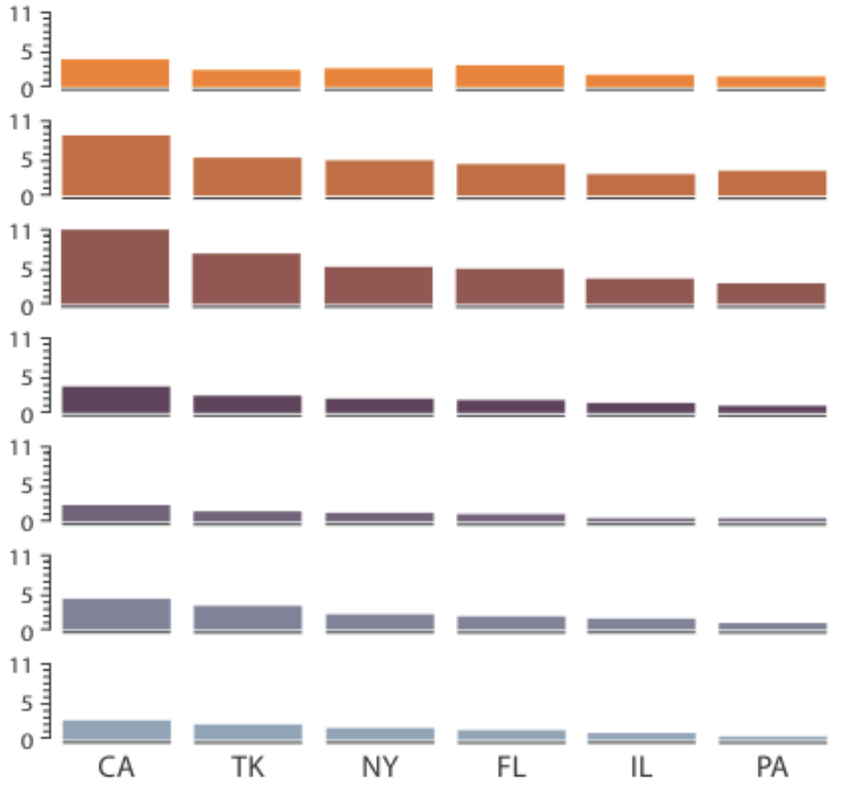
partition attribute(s)

- typically categorical

Partitioning

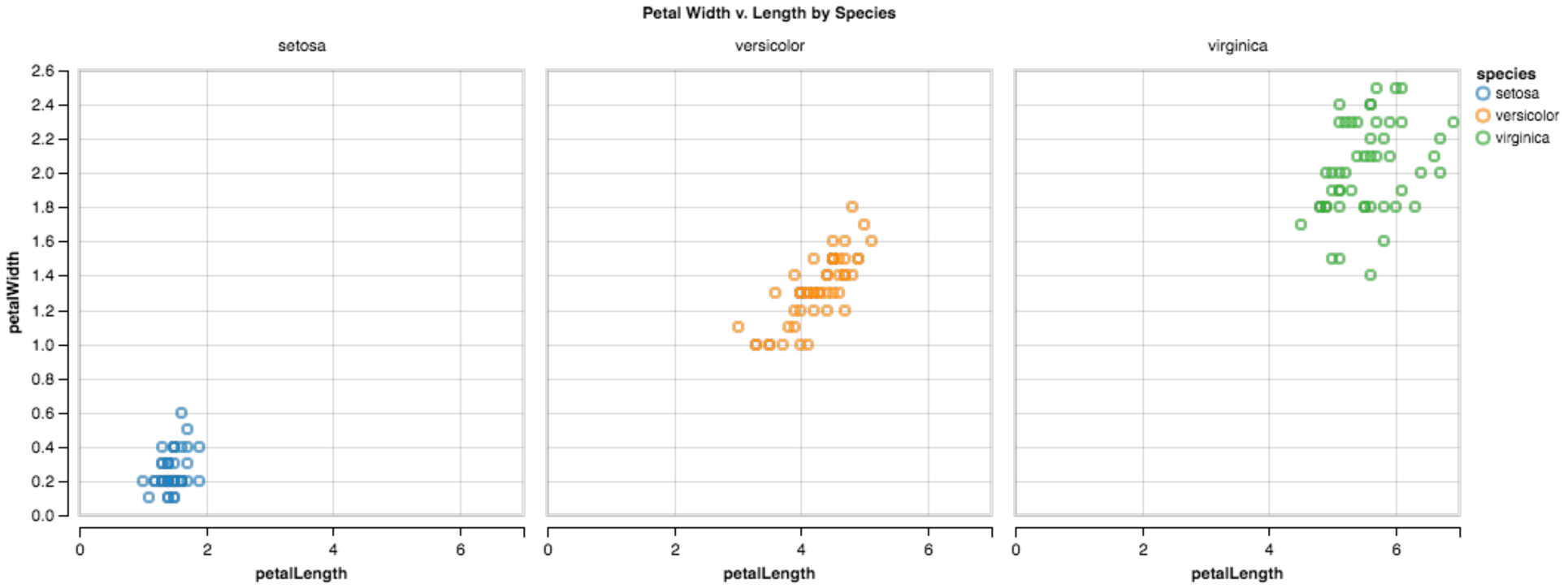


Partitioned by State



Partitioned by Age Group and State

Partition by Category



Trellis Plots

panel variables

attributes encoded in individual views

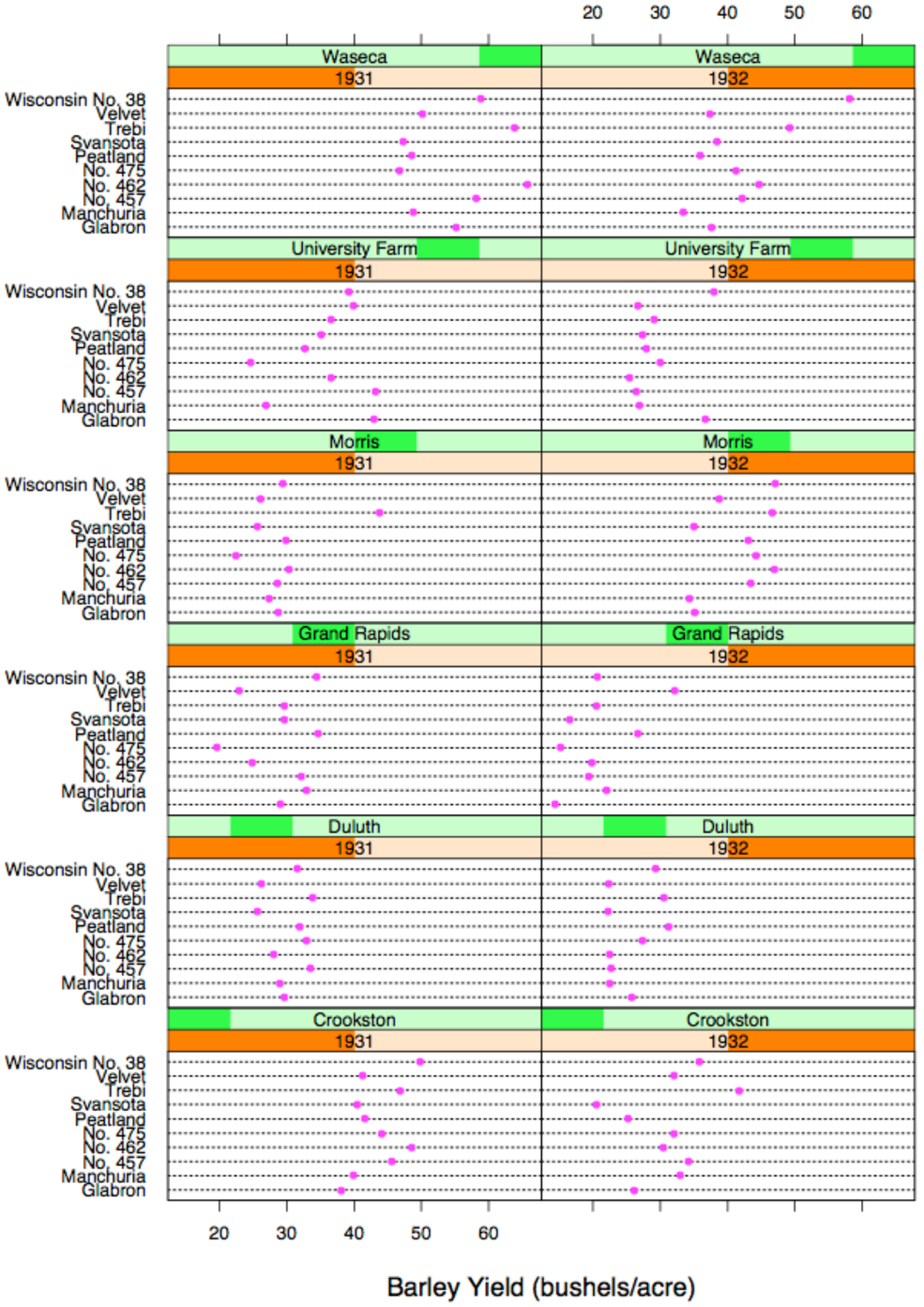
partitioning variables

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



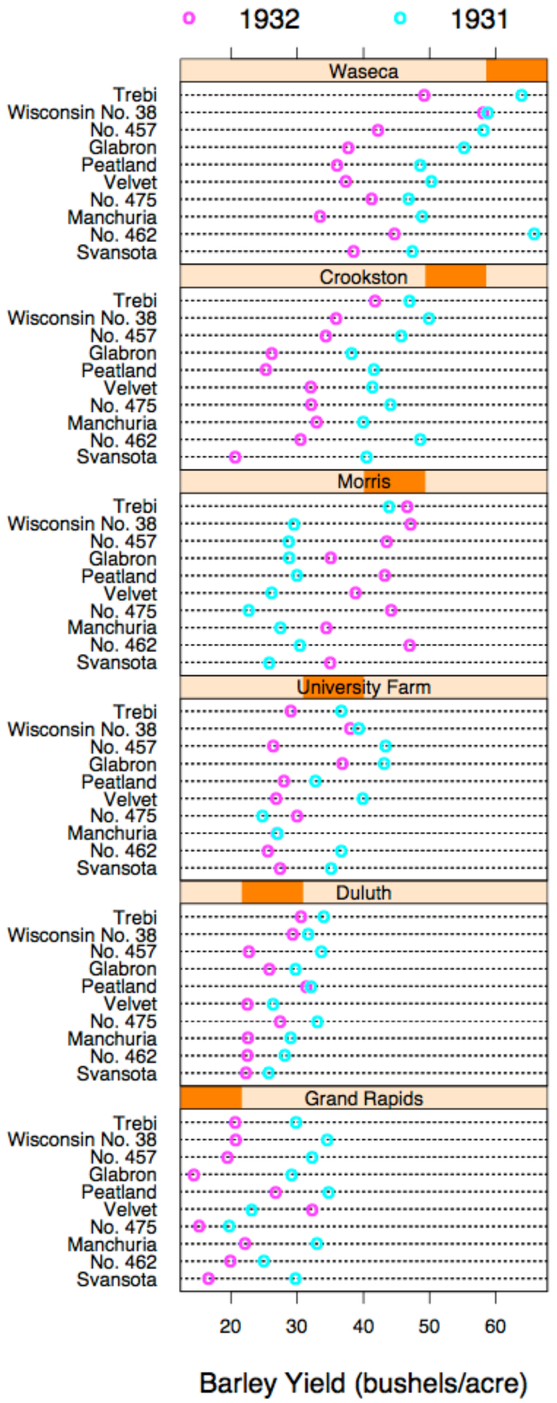
Data

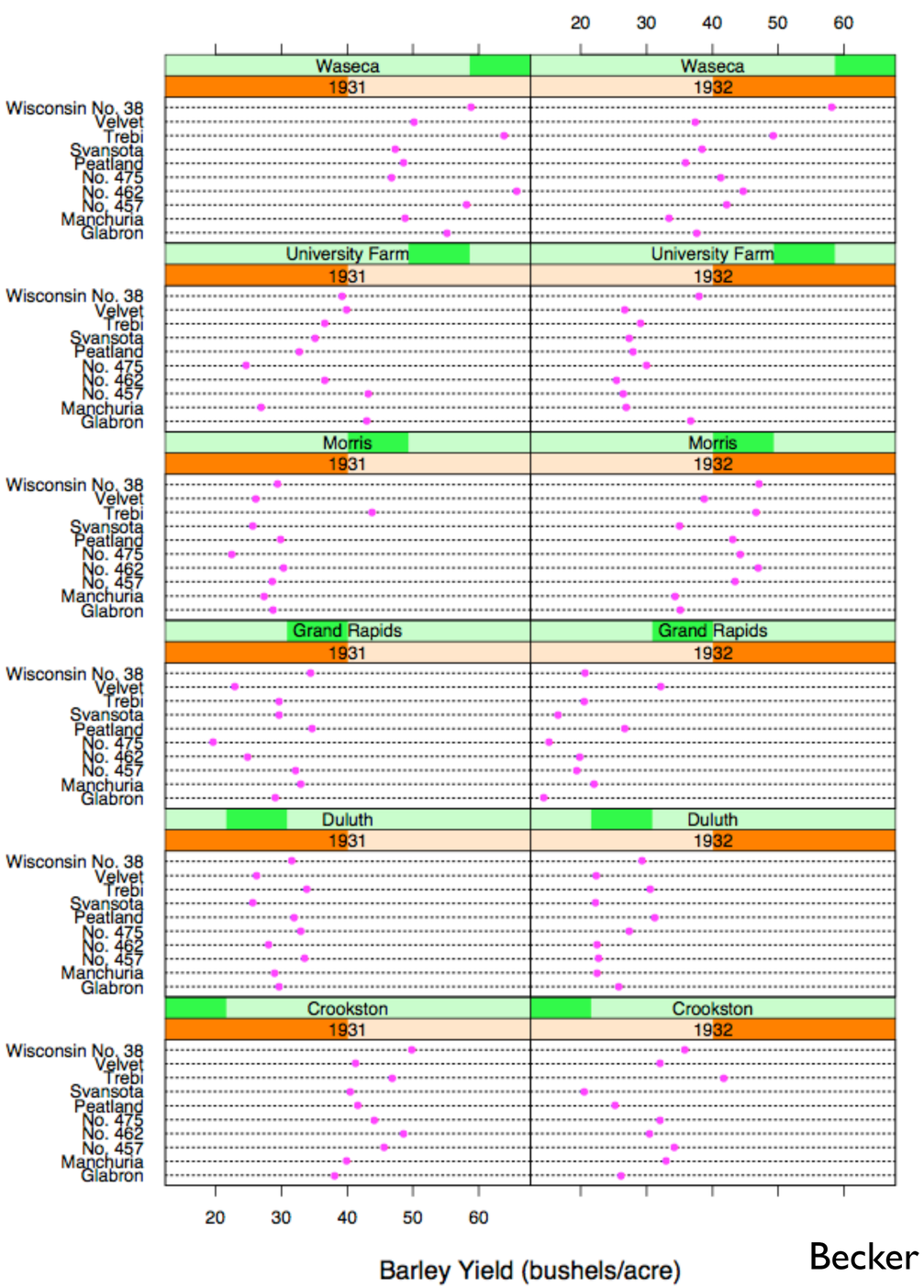
Barley Yields in two years across multiple farms for multiples barley strains

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

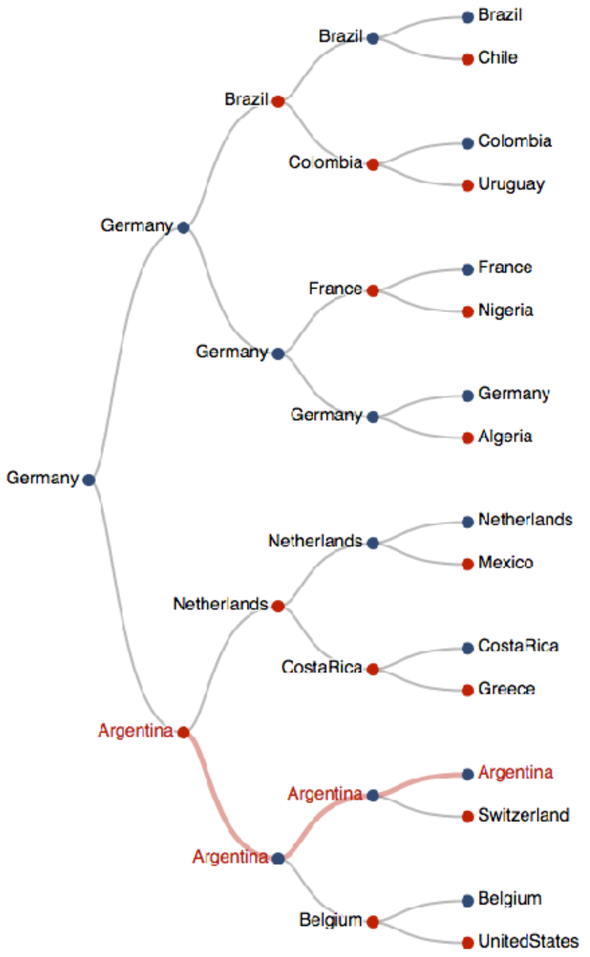
Exploring Match Statistics For 2014 World Cup CS-5630/6630 Homework

Name: YOURNAME; E-Mail: YOUREMAIL; UID: u0123456

Score Table

Team	Goals	Round/Result	Wins	Losses	Total Games
Brazil		Third Place	4	2	7
Germany		Winner	6	1	7
Argentina		Runner-Up	6	1	7
xGermany		Runner-Up			
xNetherlands		Semi Finals			
xBelgium		Quarter Finals			
xSwitzerland		Round of Sixteen			
xBosnia		Group			
xIran		Group			
xNigeria		Group			
Netherlands		Fourth Place	6	1	7
France		Quarter Finals	3	1	5
CostaRica		Quarter Finals	3	1	5
Belgium		Quarter Finals	4	1	5
Chile		Round of Sixteen	2	2	4
Uruguay		Round of Sixteen	2	2	4
Nigeria		Round of Sixteen	1	2	4
Algeria		Round of Sixteen	1	2	4
Colombia		Quarter Finals	4	1	5
Mexico		Round of Sixteen	2	1	4
Greece		Round of Sixteen	1	2	4
Switzerland		Round of Sixteen	2	2	4
UnitedStates		Round of Sixteen	1	2	4
Spain		Group	1	2	3
England		Group		2	3
CotedIvoire		Group	1	2	3
Iran		Group		2	3
Ghana		Group		2	3
Russia		Group		1	3
Australia		Group		3	3
Cameroon		Group		3	3
Japan		Group		2	3
Italy		Group	1	2	3
Honduras		Group		3	3
Korea		Group		2	3
Croatia		Group	1	2	3
Bosnia		Group	1	2	3
Ecuador		Group	1	1	3
Portugal		Group	1	1	3

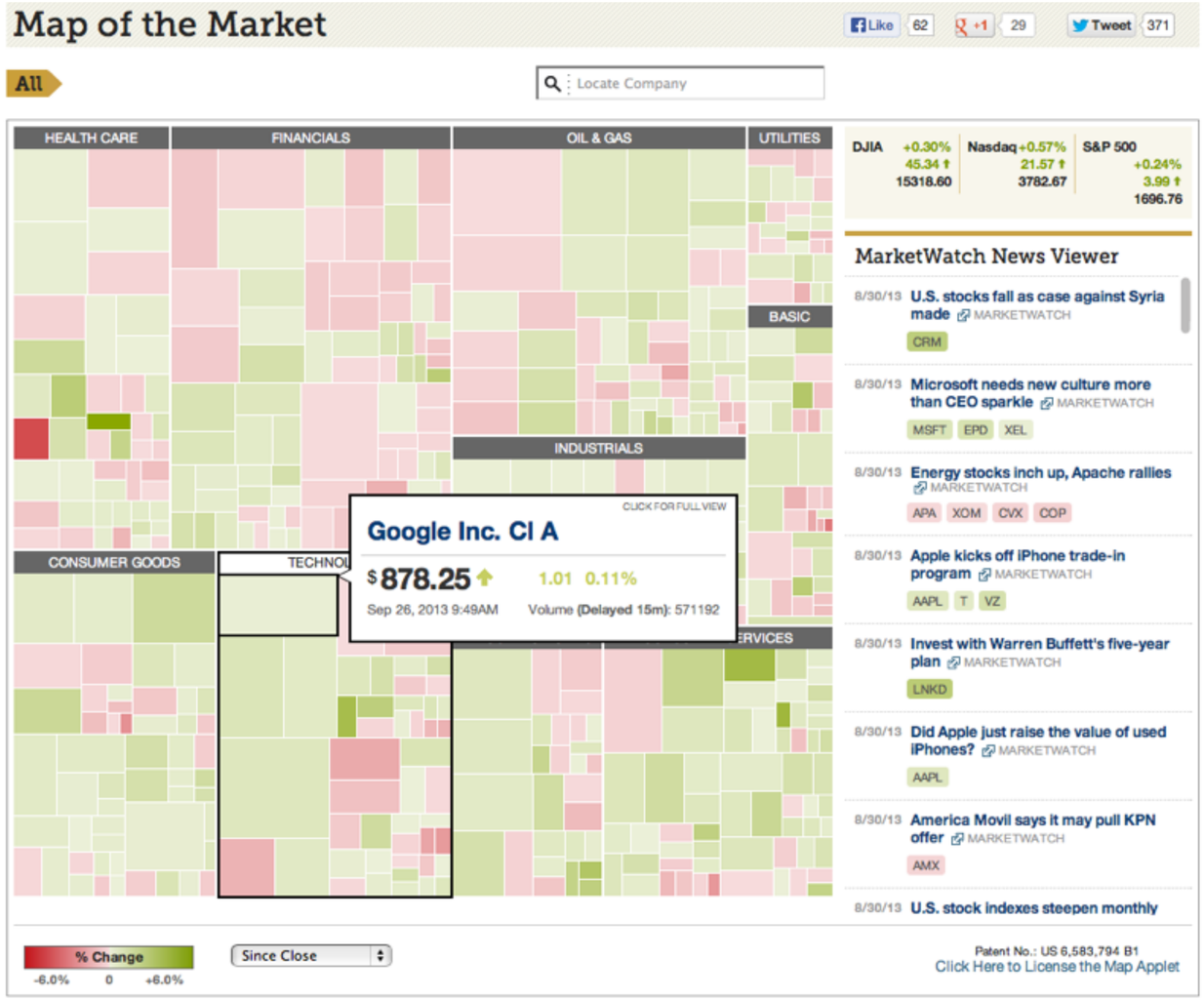
Second Stage



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

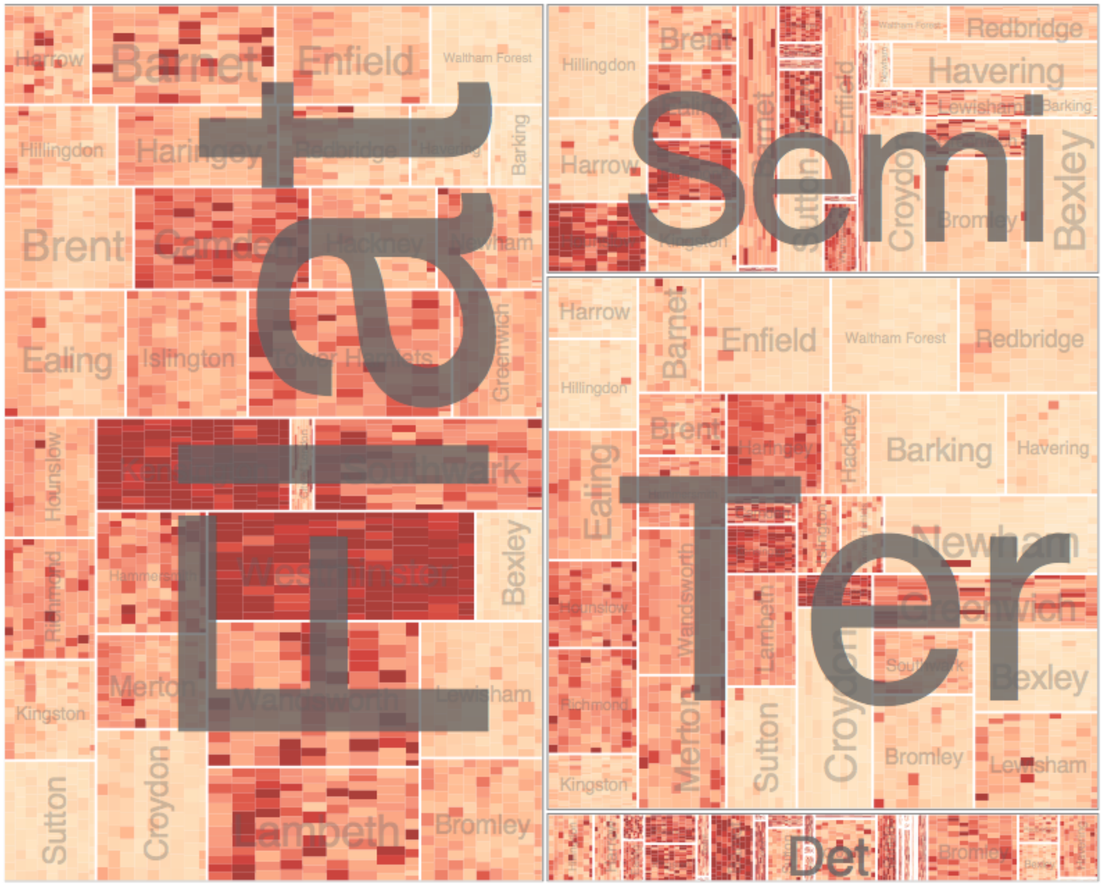
encoding attributes

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

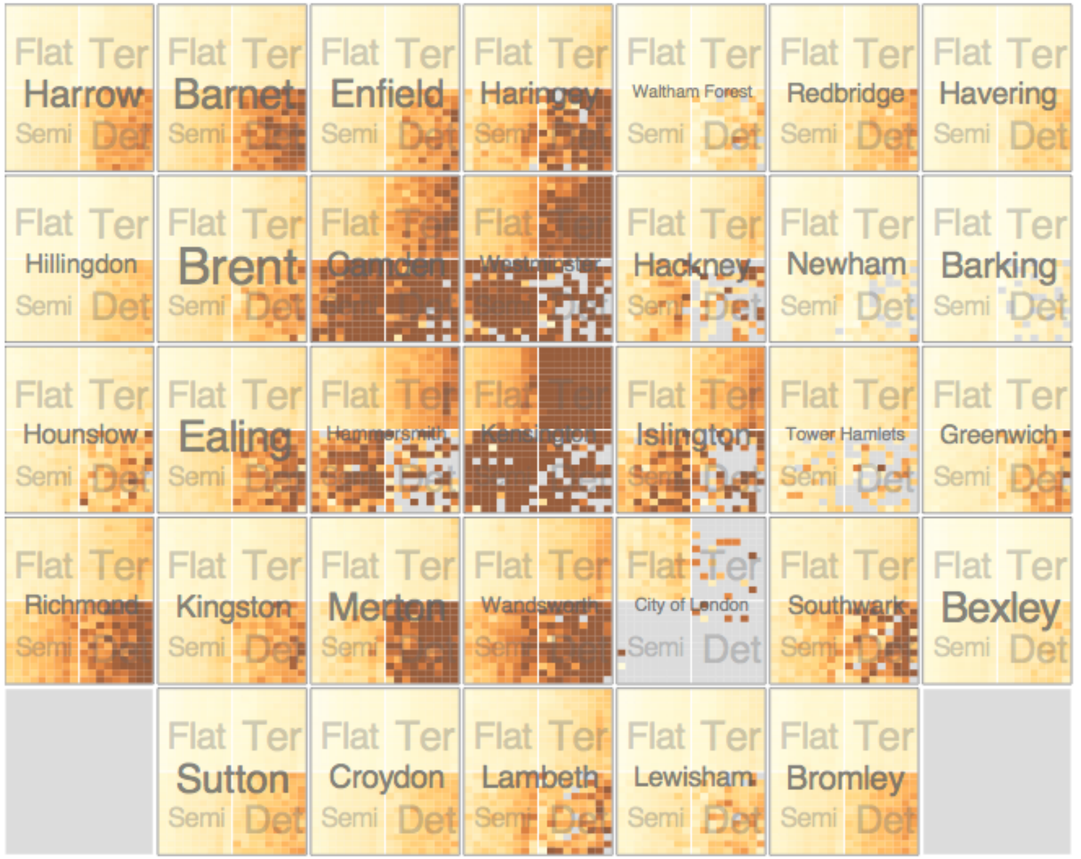
neighborhood location
neighborhood
house type
sale time (year)
sale time (month)

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/

LAYERING

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

rational

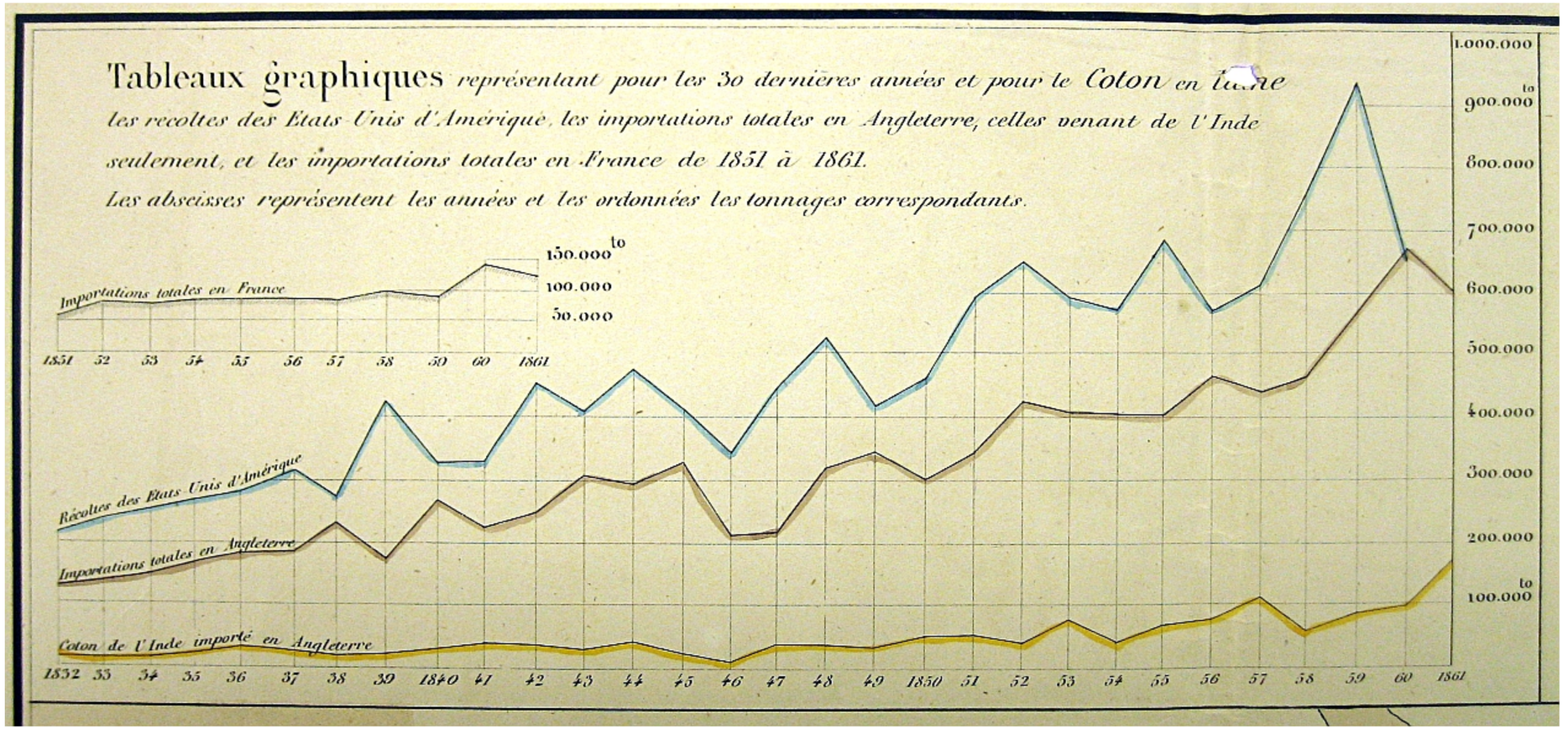
supports a larger, more detailed view than using multiple views

trade-off

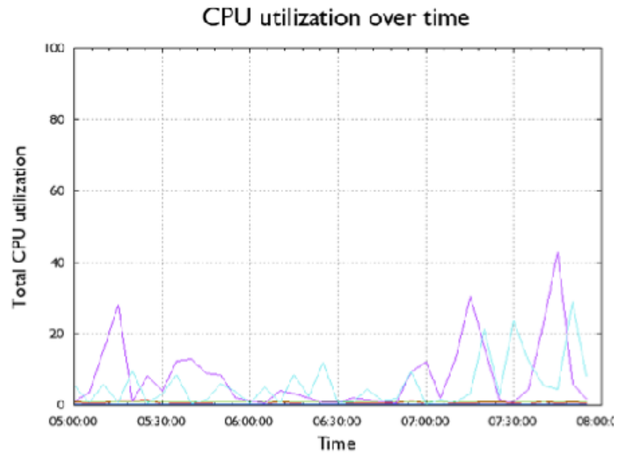
layering imposes constraints on visual encoding choice as well as number of layers that can be shown

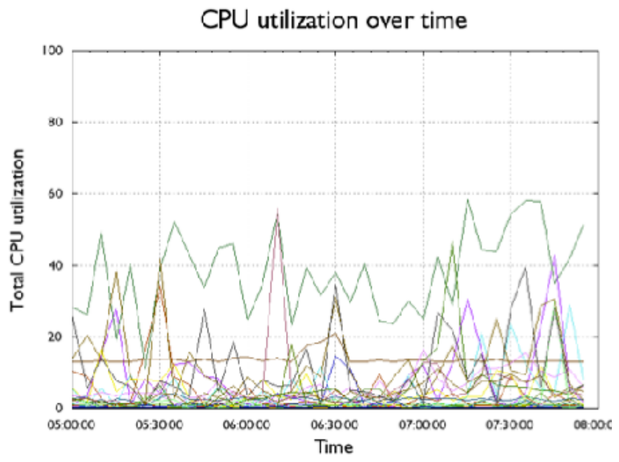
JOSEPH MINARD

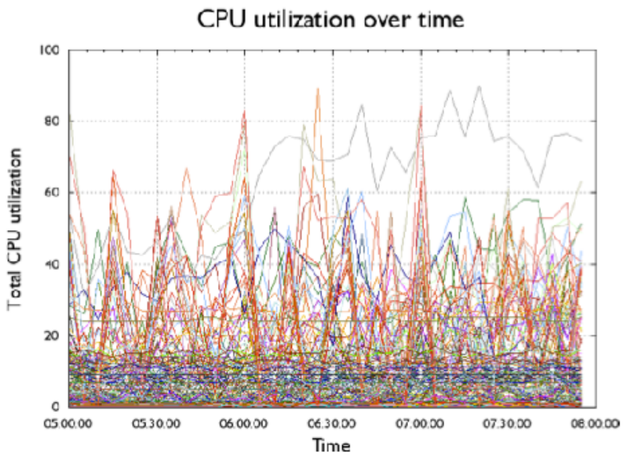
1781-1870



overlays


CPU utilization over time
Total CPU utilization
Time

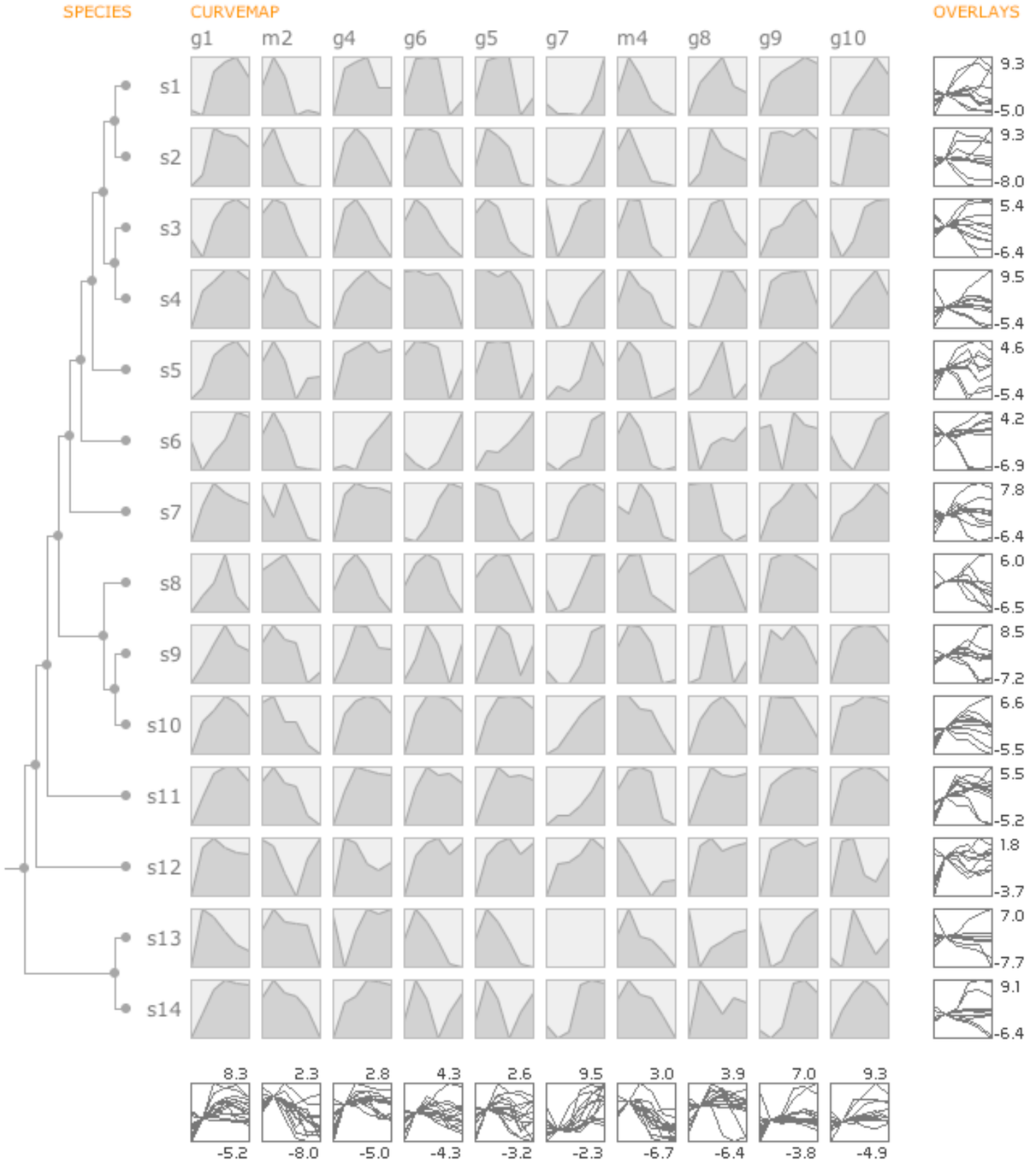

CPU utilization over time
Total CPU utilization
Time


CPU utilization over time
Total CPU utilization
Time

Combined

Partitioned + layered graph

Synchronized through highlighting



MCV to the Max