Information Visualisation (5) Manipulating and Faceting Views

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Course Outline

- Introduction to Information Visualisation
- Data, Task and Validation
- Marks and Channels; Color Mapping
- Tables, Spatial data, Networks and Trees
- Manipulating View, Facetting, Focus + Context
- Reduce Items and Attributes + Some Cases Analysis

Program for Today

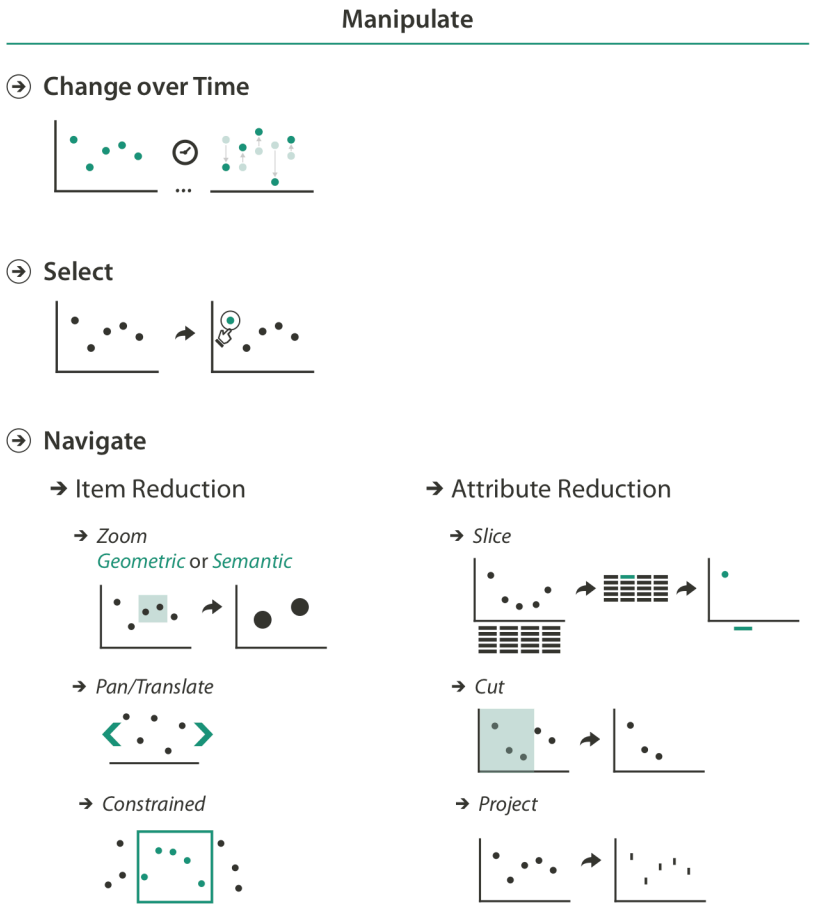
- Interaction and manipulation
- Facetting

Why Change/Manipulate the View?

- Datasets often large and complex
  - Especially in data science…
- Showing everything on the screen leads to visual clutter
- Five possibilities for handling complexity
  - Deriving new data (as seen in chapter 2)
  - Manipulating the view
  - Facetting the data (seen later today)
  - Reducing/filtering the amount of data
  - Embedding focus + context
- Lets the user decide some design choices (instead of only the designer)

Manipulating the View: Possibilities

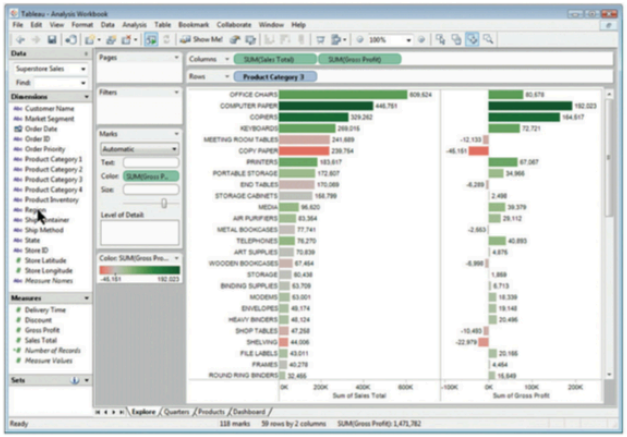
- Changing the view over time
- Selecting elements
- Changing viewpoint
- Reducing attributes



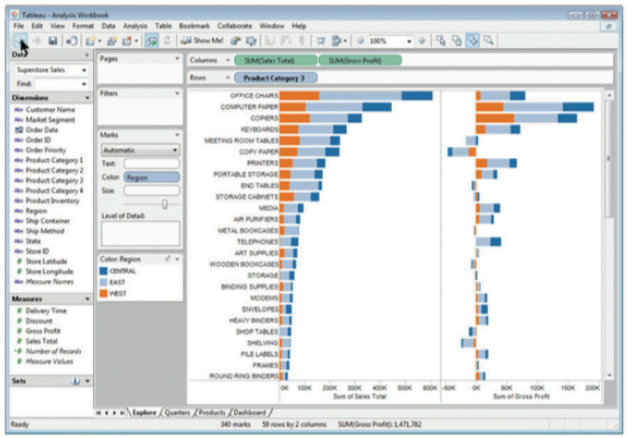
Manipulation: Changing View Over Time

- Change can happen over any of the "*how*" idioms !
  - Change encoding
  - Change arrangement
  - Change order
  - Change viewpoint
  - Change filtering
  - Change aggregation level
  - …

Changing View Over Time: Idioms Example



(a)



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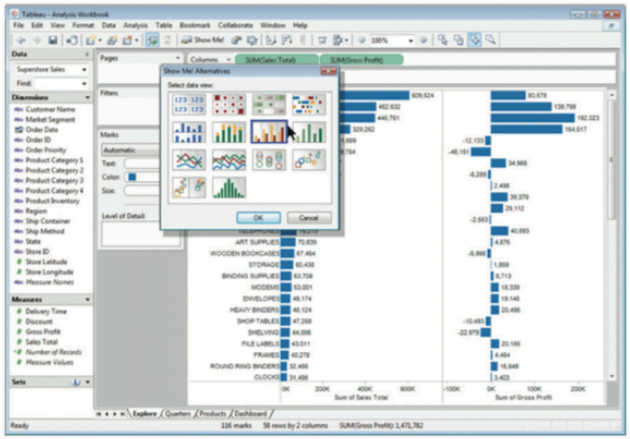
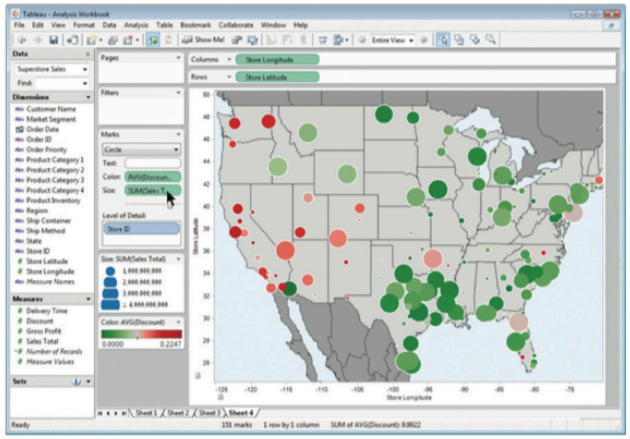
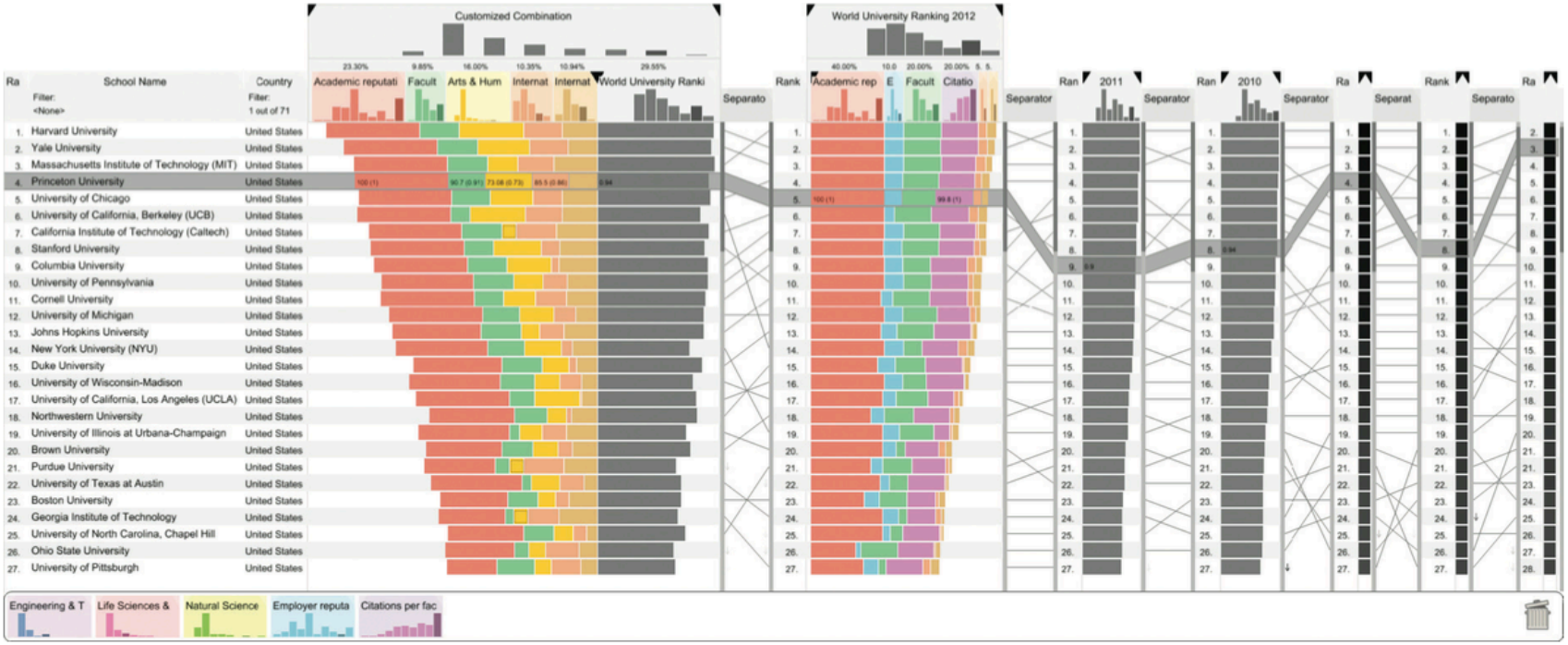




Changing View Over Time: Reordering Example



Changing View Over Time: Alignment Example

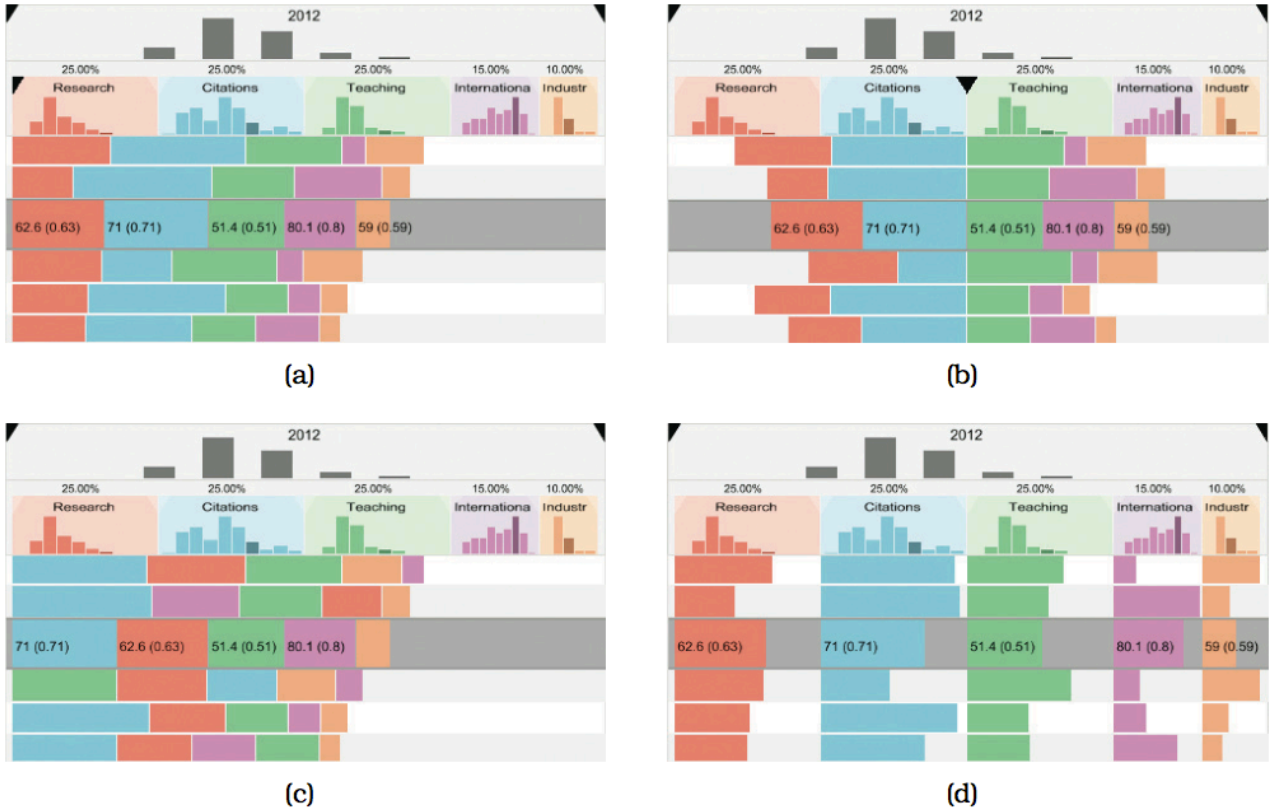
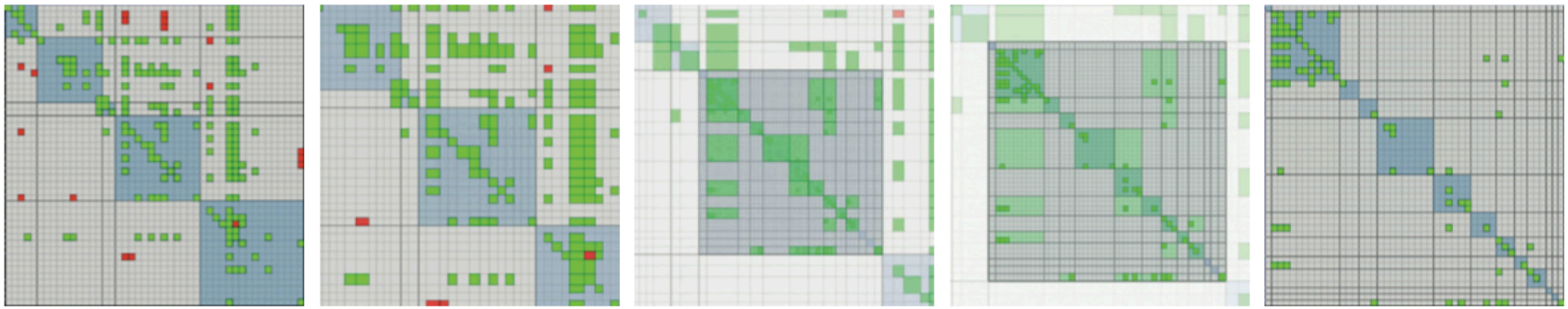


Figure 11.4. Changing the alignment in Lineup. (a) Classical stacked bars. (b) Diverging stacked bars. (c) Ordered stacked bars. (d) Separately aligned bars: small multiple bar charts. From [Gratzl et al. 13, Figure 4].

Special Case: Animation

- Change of the view over time, following (or not) a user input
- Good use of animation: animated transitions
  - Explicitly show how an item in the first state moves to its new position in the second state
  - Help users maintain a sense of context
  - Work well when either a small number of objects change while the rest stay the same, or when groups of objects move together in similar ways

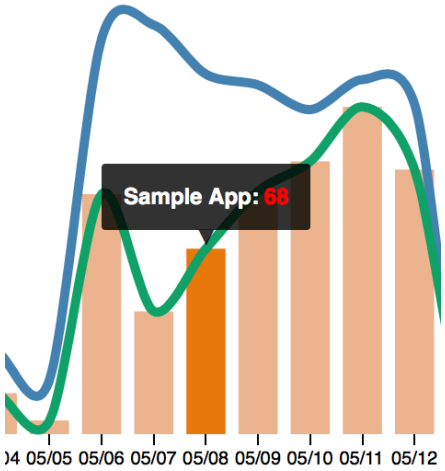


Manipulation: Selecting Elements

- Fundamental action
- Selection design choices: what elements?
  - Data items
  - Links
  - Data attributes
  - Data attribute levels
- Selection design choices: which kind of selection?
  - Hovering
  - Simple click
  - Double click...

Selecting Elements – Highlighting

- Selection should trigger highlighting
  - Feedback to the user through immediate visual feedback
  - Confirmation
- Highlighting visual idioms possibilities
  - Color change
    - ... If your colormap lets you select one more!
  - Outline
  - Size channel
  - Shape channel
    - E.g. for links, changing a continuous line with a dashed one
  - Motion coding
    - Oscillations, dash pattern crawling around elements

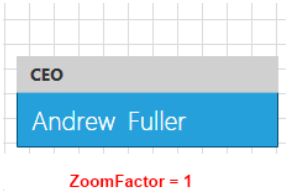


Navigation: Changing Viewpoint

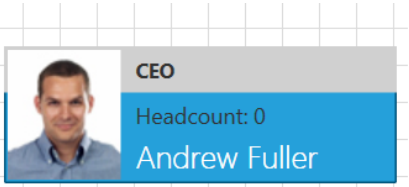
- … E.g. « scrolling »
- Navigation: changing the point of view from which things are drawn
- Three components:
  - Zooming
  - Panning (translating)
  - Rotating
- Changing the viewpoint can lead to filtering/unfiltering and/or aggregating shown data

Changing Viewpoint: Semantic Zooming

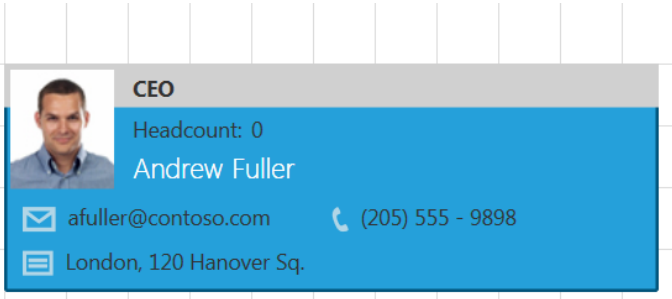
- Geometric zooming vs. Semantic zooming
  - Geometric zooming: appearance of objects is fixed, only their size changes with the level of zoom
  - Semantic zooming: representation of the object adapts with to the number of pixels available



ZoomFactor = 1



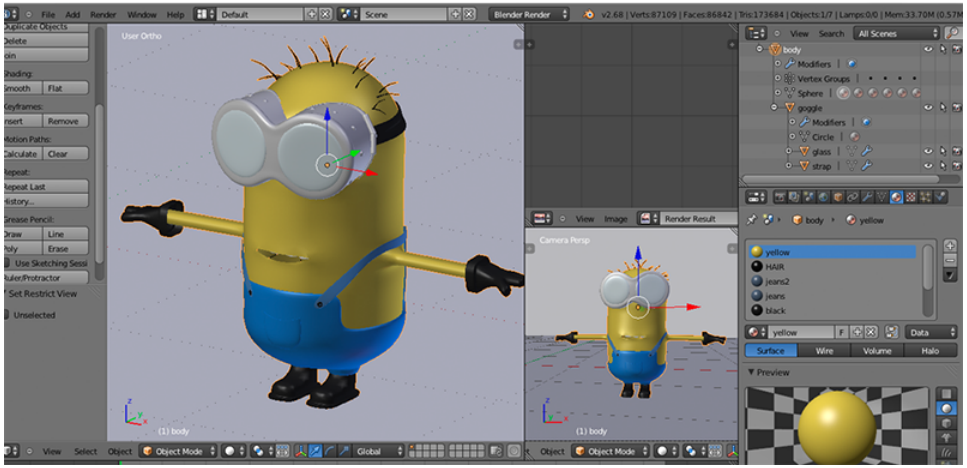
ZoomFactor = 1.5



ZoomFactor = 2.5

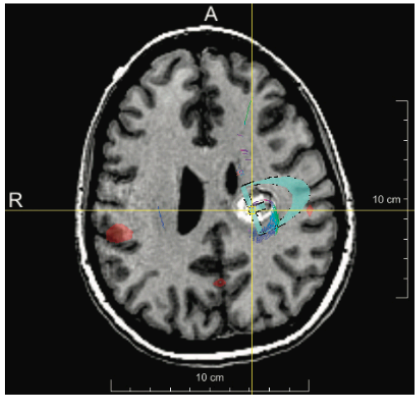
Navigation: Unconstrained vs. Constrained

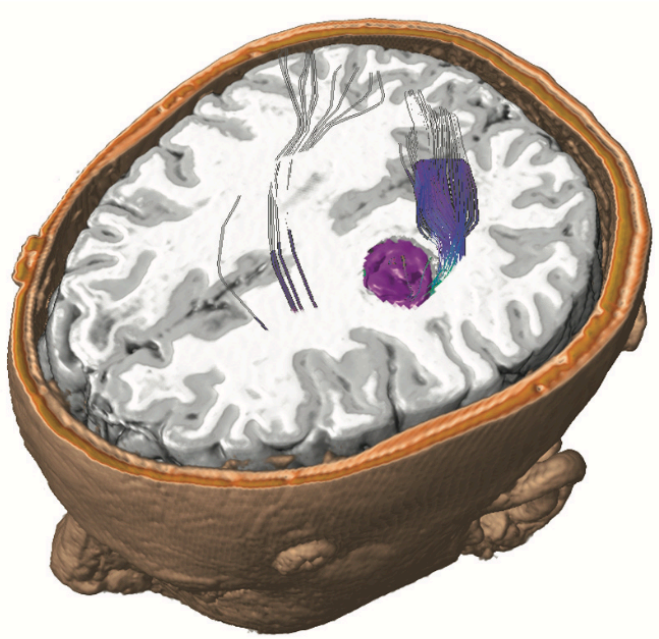
- Unconstrained navigation: the camera can move anywhere
  - Easy to implement, sometimes less easy to use
  - Navigation in 3D space not a simple skill, for example
- Constrained navigation: limits are imposed
  - Limiting the zoom range, for example
  - Or forcing the final orientation in a 3D visualisation



Navigation: Reducing Attributes

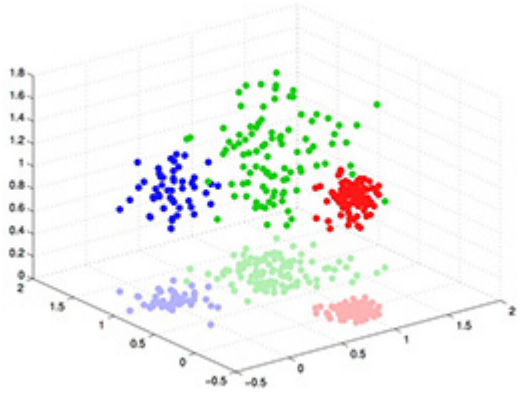
- Slicing: eliminating a dimension to show only selected points
- Cutting: Removing parts of the data to show only parts of it





Navigation: Reducing Attributes

- Projection: all items of data are shown, but information from some dimension is excluded
  - Simple exemple: a shadow is a kind of projection
- Multiple different types of projections:
  - Orthographic projection
  - Perspective projection
  - Map projections
  - ...

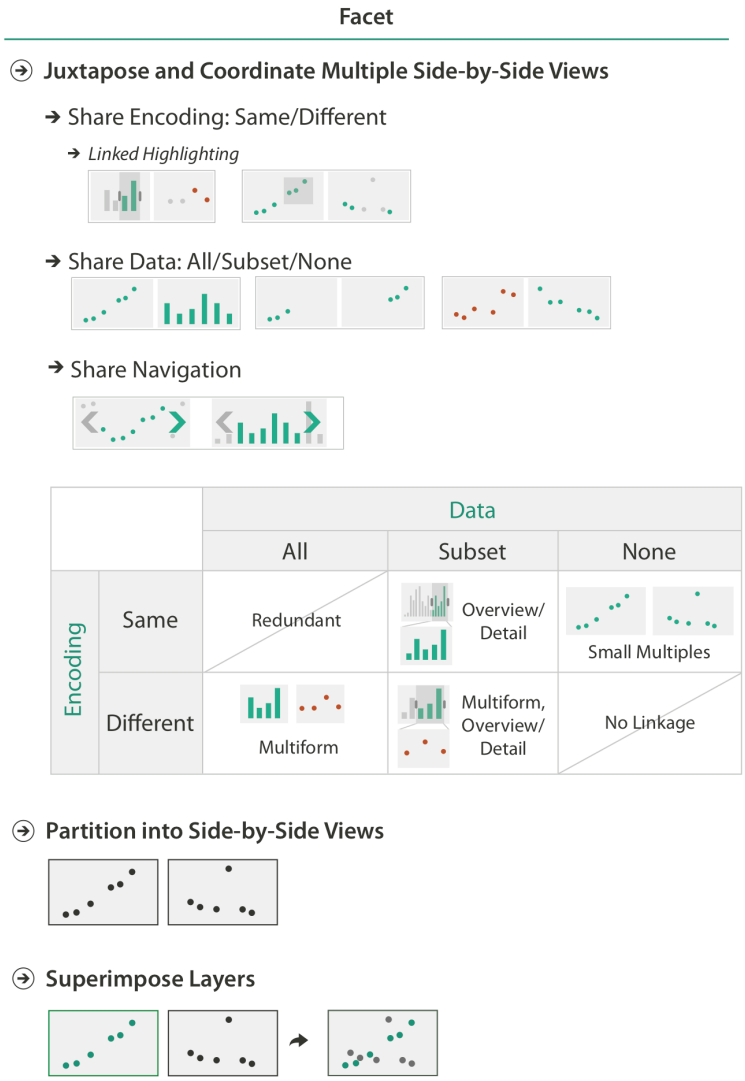


Facetting into Multiple Views

- https://bl.ocks.org/mbostock/4063663

Facetting into Multiple Views

- Juxtapose and coordinate views
  - Share encoding: same/different
  - Share data: all, subset, none
  - Share navigation: synchronise
- Partition into views
  - List alignments
  - Matrix alignments
  - Recursive subdivisions
- Superimpose layers



Juxtaposing and Coordinating Views

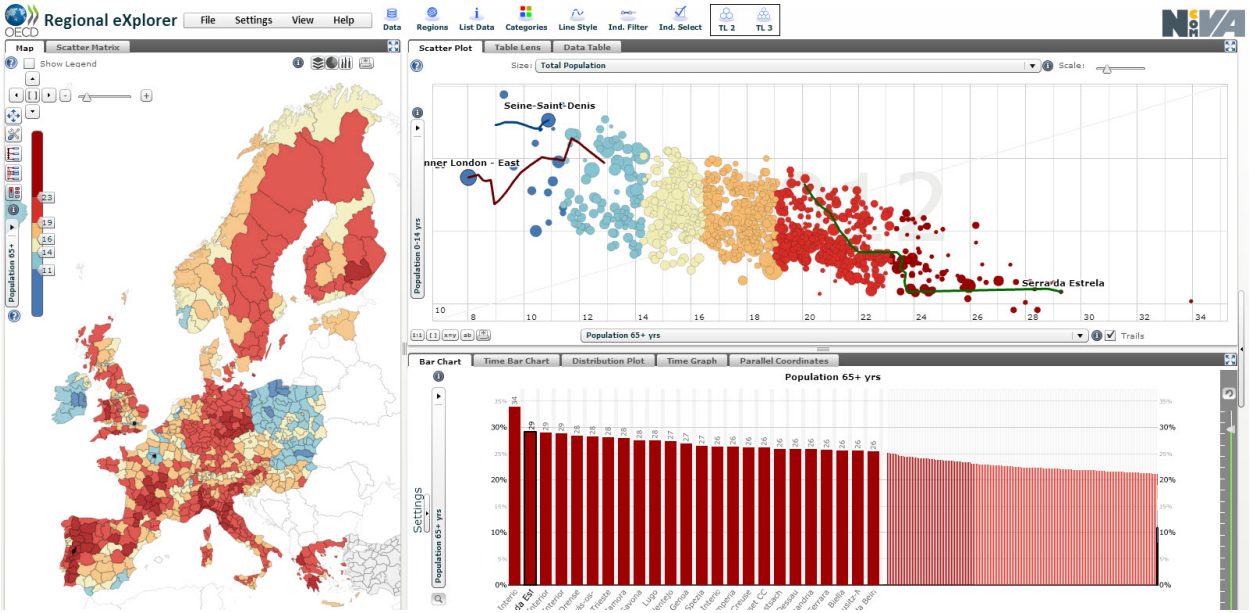
- Goal: create linked views!
- Four design choices:
  1. Do the views share the same visual encoding or use different encodings?
  2. Is highlighting linked between the views?
  3. Do the views show the same data, does one show a subset of what's in the other, or do the views show a disjoint partitioning where each shows a different set?
  4. Is navigation synchronized between the views?

Design choice 1 – Sharing Encoding: Same/ Different

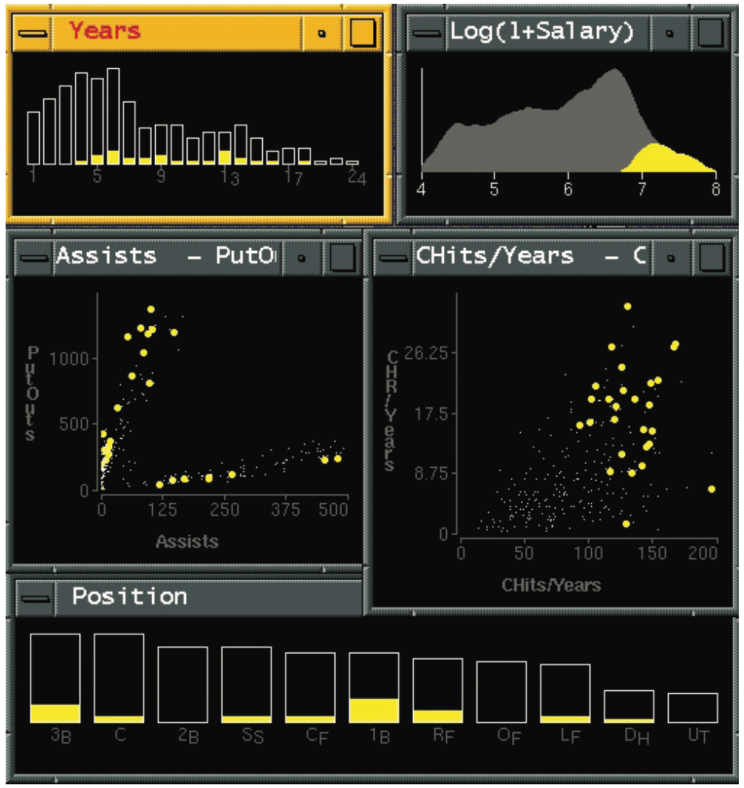
- Typical case: a visual channel (colour, e.g.) is used in the same way across mutiple views
  - Shared encoding views: all channels are handled the same way
  - Multiform views: some, but not necessarily all channels differ between the views

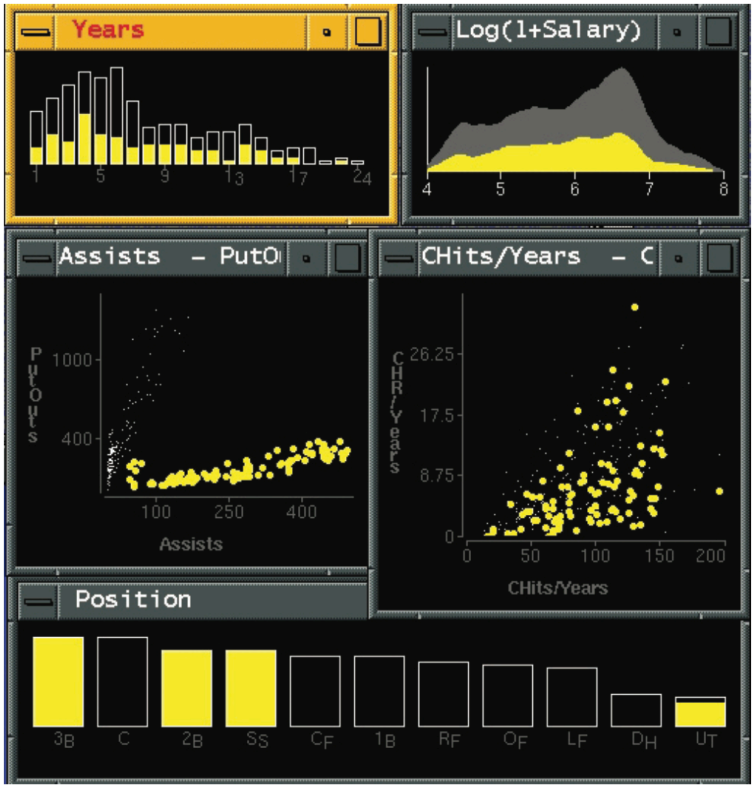
Design choice 2 – Common Highlighting

- Linked highlighting: items that are interactively selected in one way are immediately highlighted across all views
  - Gives alternate visualisation for the same data
  - Other name: linking and brushing



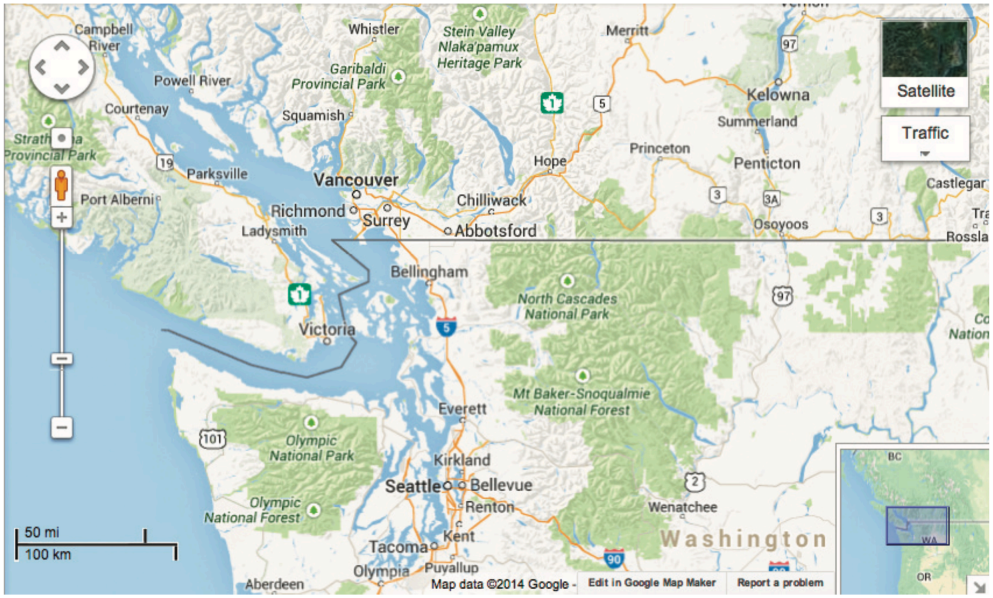
Linking and Brushing Example





Design choice 3 – Share Data: All, Subset, None

- How much data is shared between the two views
  - Shared data: both view show all of the data
  - Overview/detail: one view shows a subset of what is in the other
    - Variant: detail-on-demand
  - Small multiples: each view shows different partitions of the data



Multiform Overview-Detail Example

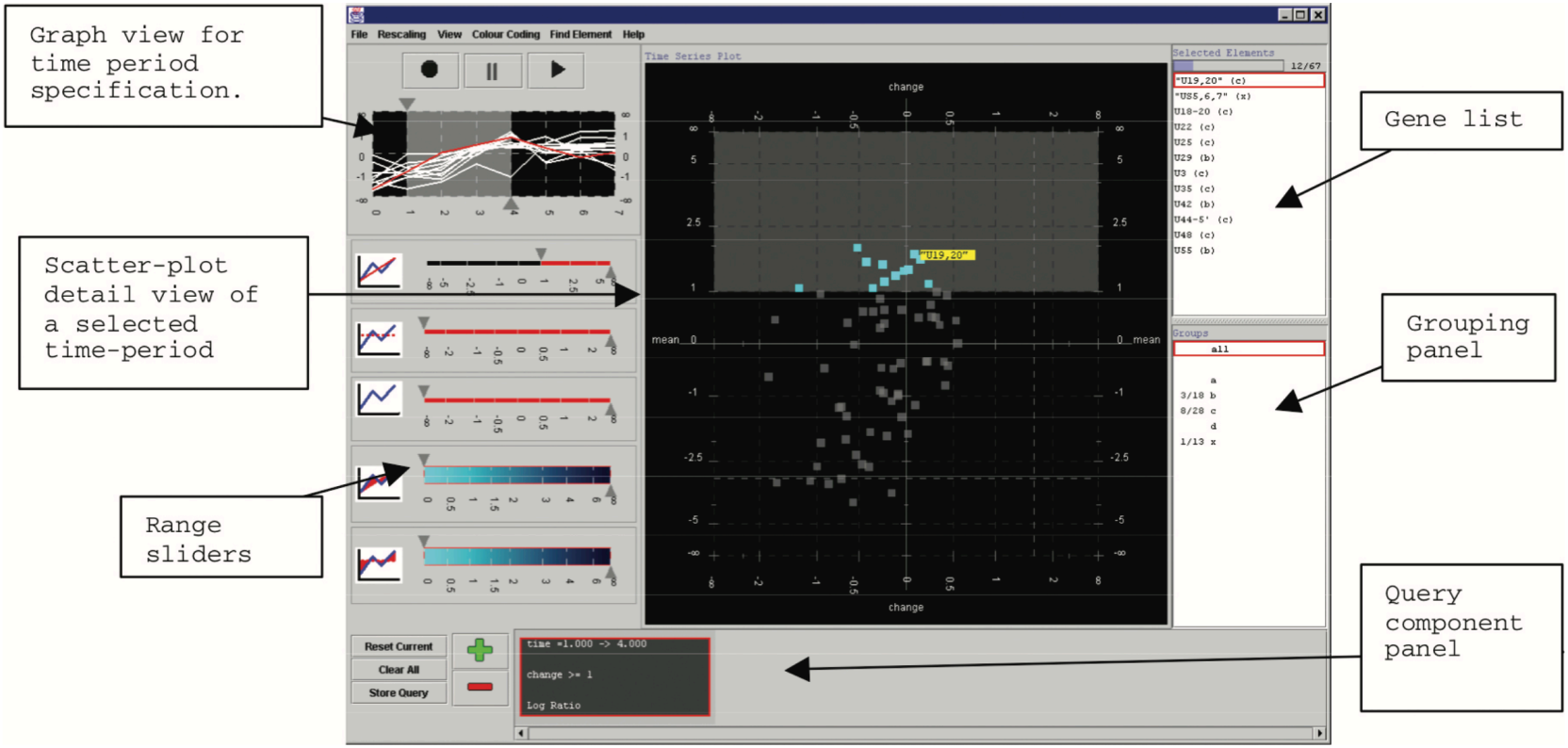
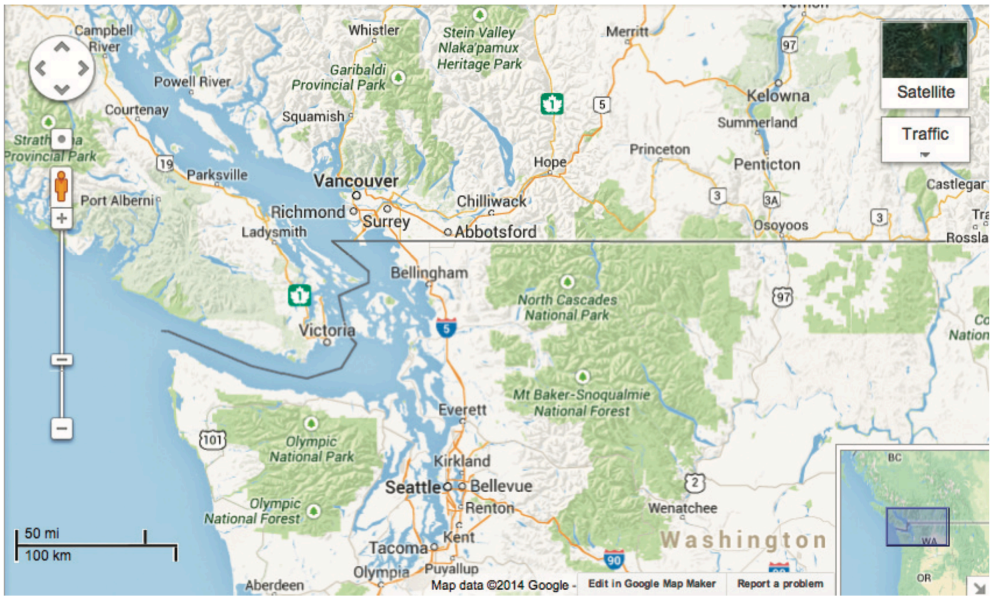


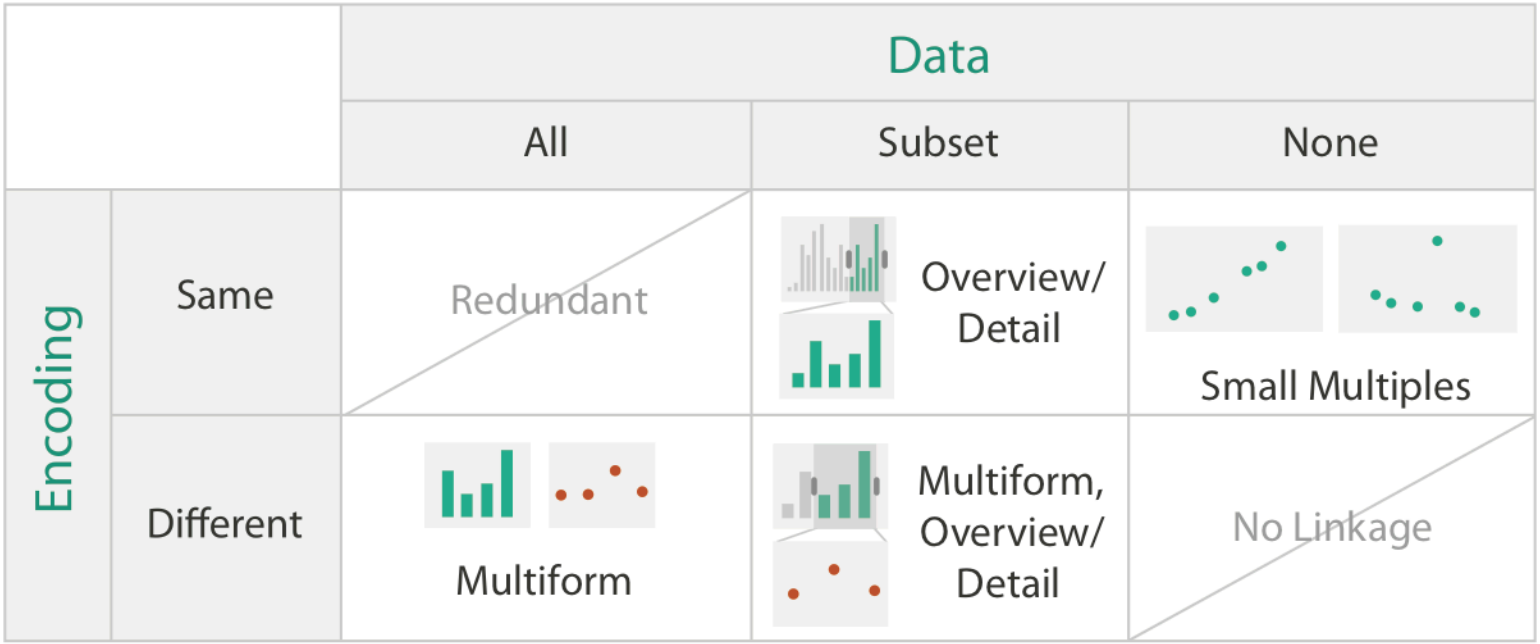
Figure 12.4. Multiform overview–detail vis tool for microarray exploration features a central scatterplot linked with the graph view in the upper left. From [Craig and Kennedy 03, Figure 3].

Design choice 4: Share Navigation

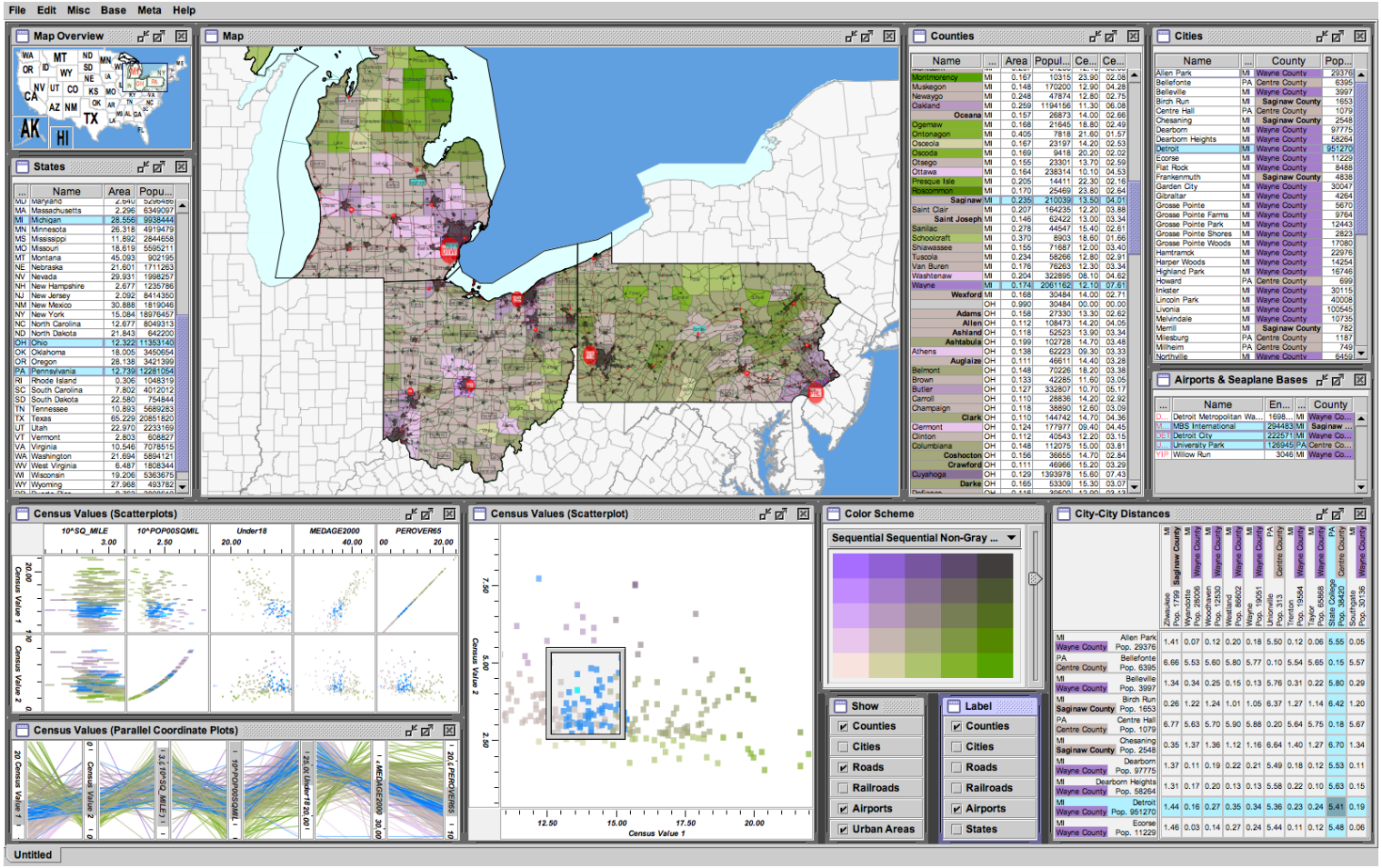
- Linked navigation: moving the viewpoint in one view is synchronized in the other view



Juxtaposing and Coordinating Views: Combinations



Combining Everything...



http://www.cs.ou.edu/~weaver/improvise/examples/census/index.html

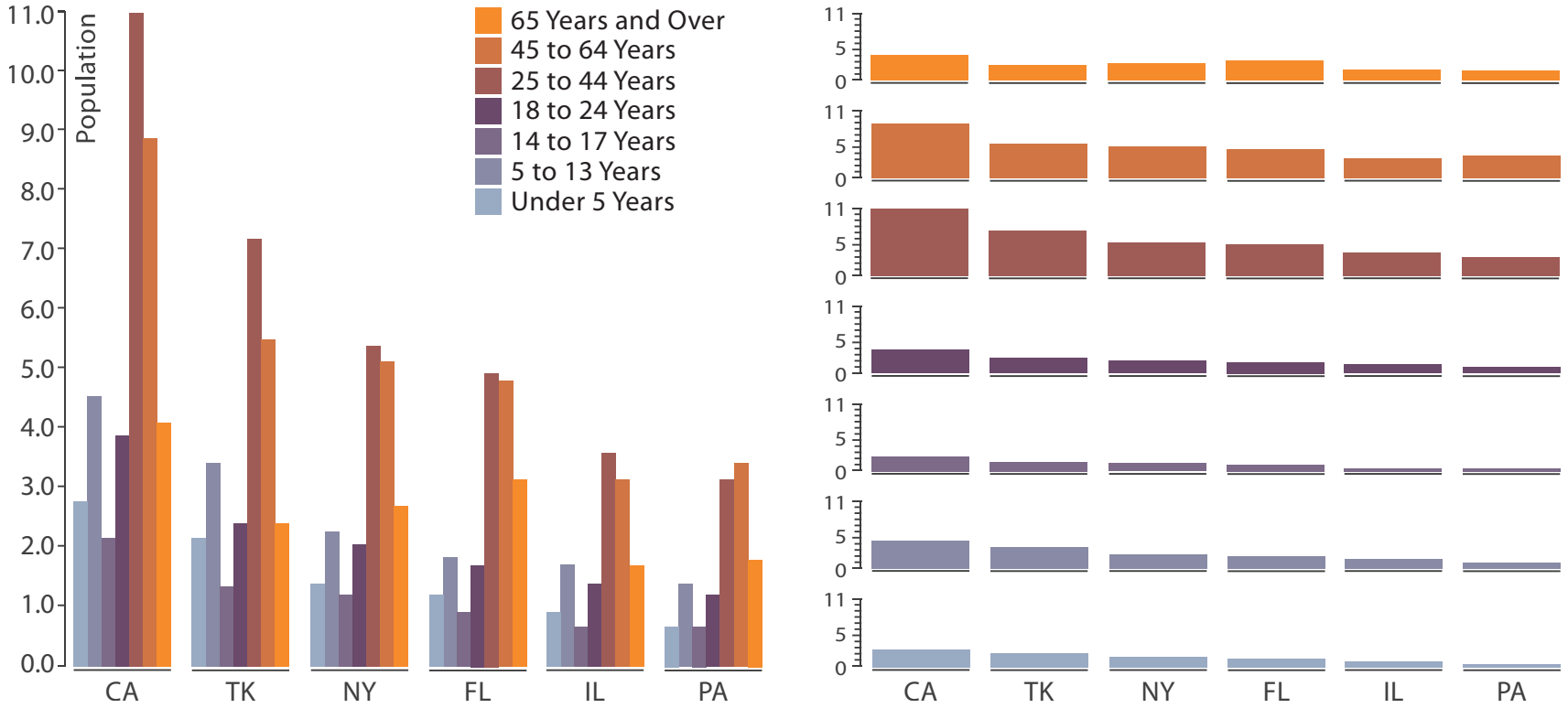
Combining Everything…

System	**Improvise**
What: Data	Geographic and multidimensional table (census data): one key attribute (county), many quantitative attributes (demographic information)
How: Encode	Scatterplot matrix, parallel coordinates, choropleth map with size-coded city points, bird's-eye map overview, scatterplot, reorderable text lists, text matrix. Bivariate sequential–sequential colormap
How: Facet	Partition: small-multiple, multiform, overview–detail views; linked highlighting

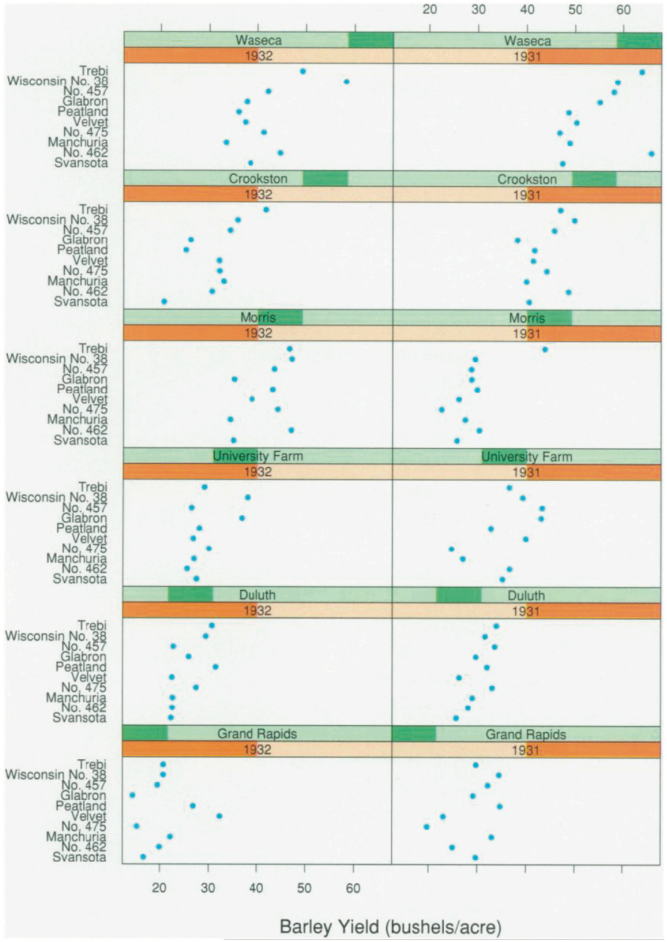
Partitioning into Views

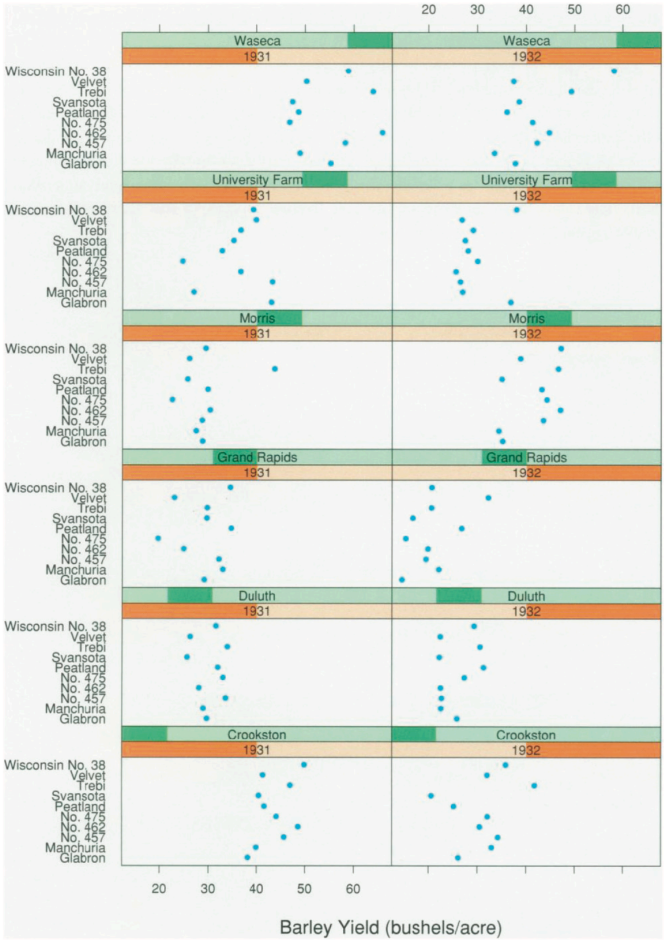
- Design choice: how to partition?
  - Major implications for what kind of patterns are visible to the user
- How to divide the data up between the views?
- How many views?
- Which attribute is used to drive the partition?
  - Categorical? Ordered, using fixed indexes?
- Three main types of alignments:
  - List alignment
  - Matrix alignment
  - Recursive subdivision

Partitioning into Views: List Alignment Example



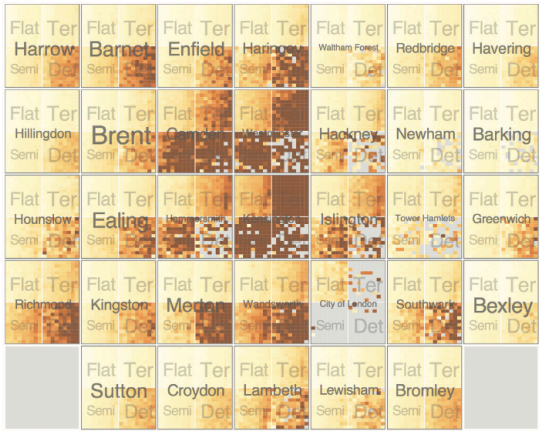
Partitioning into Views: Matrix Alignment Example





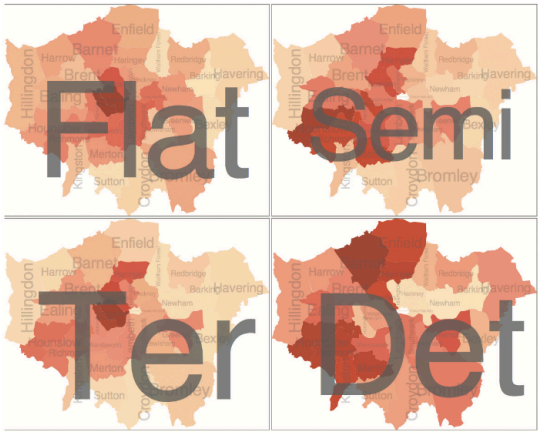
Partitioning into Views: Recursive Subdivision Example

(a)



(b)

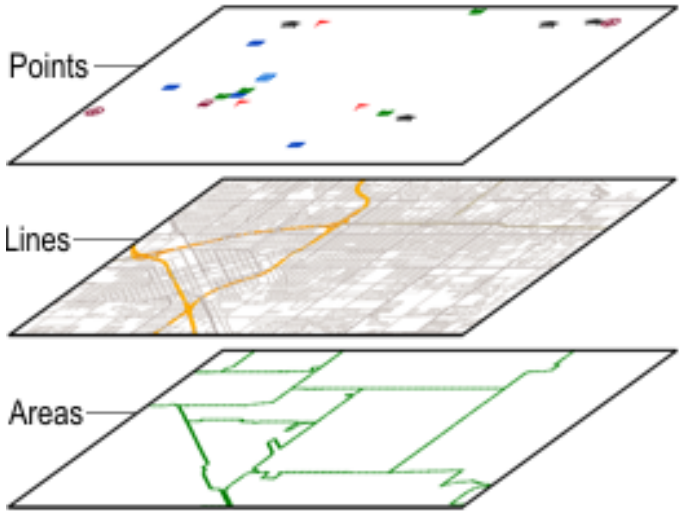
(a)



(b)

Superimposing Layers

- Combining multiple layers together by stacking them directly on top of each other
  - All layers have the same horizontal and vertical extent
  - All layers are blended together
  - Possibility to filter layers out



Superimposed Layers vs. Juxtaposed Filled Area Charts

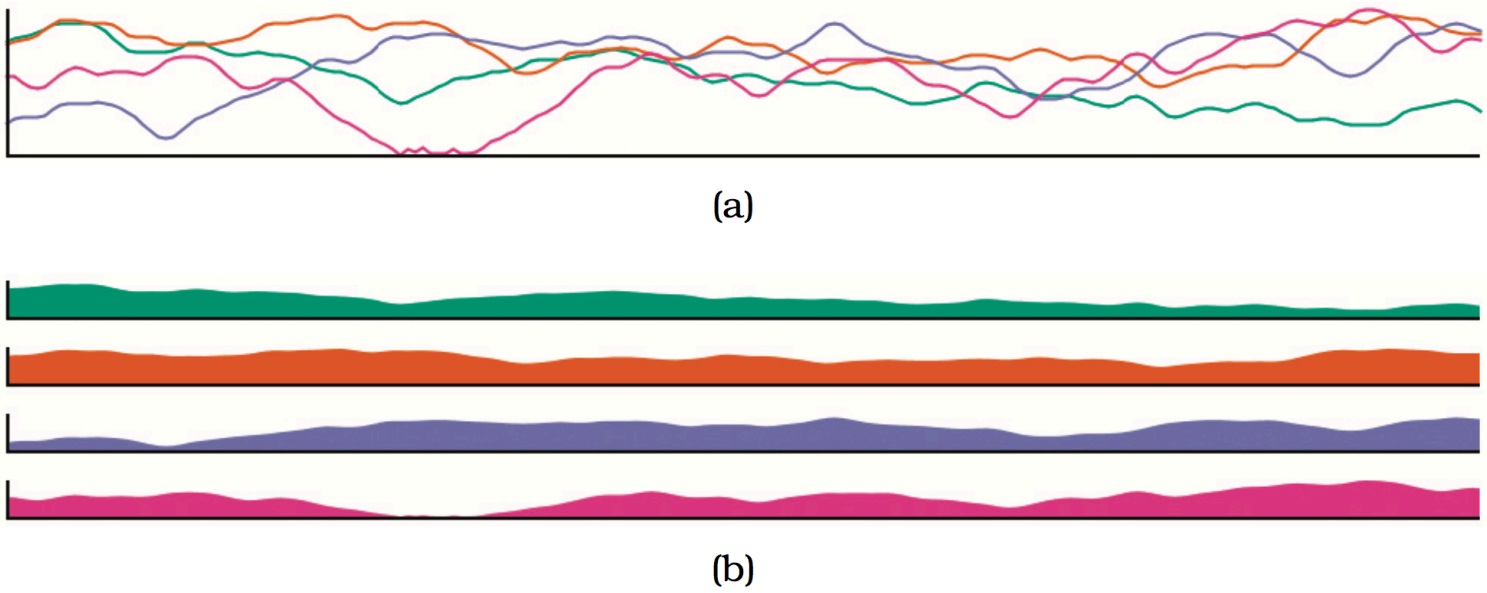


Figure 12.15. Empirical study comparing superimposed line charts to juxtaposed filled-area line charts. (a) Superimposed line charts performed best for tasks carried out within a local visual span. (b) Juxtaposed filled area charts were best for global tasks, especially as the number of time series increased. From [Javed et al. 10, Figures 1 and 2].

Next Week:

- Filtering and aggregating !