

Communicating with Data – Introduction to Interactive Visualization

Dr. Ab Mosca (they/them)

Slides based off slides courtesy of Jordan Crouser (<https://jcrouser.github.io/>)

Announcements

- On 11/07 we will have a guest lecture from the [Spatial Analysis Lab \(SAL\)](#) on geospatial visualization

Plan for Today

- Interaction: a definition
- Interaction with data and problem space
 - Relationship between interaction and understanding
- Interaction with visual interfaces
 - Basic interaction types
- Demo: coordinated multiple views

Rewind

Humans and machines have **complimentary strengths**

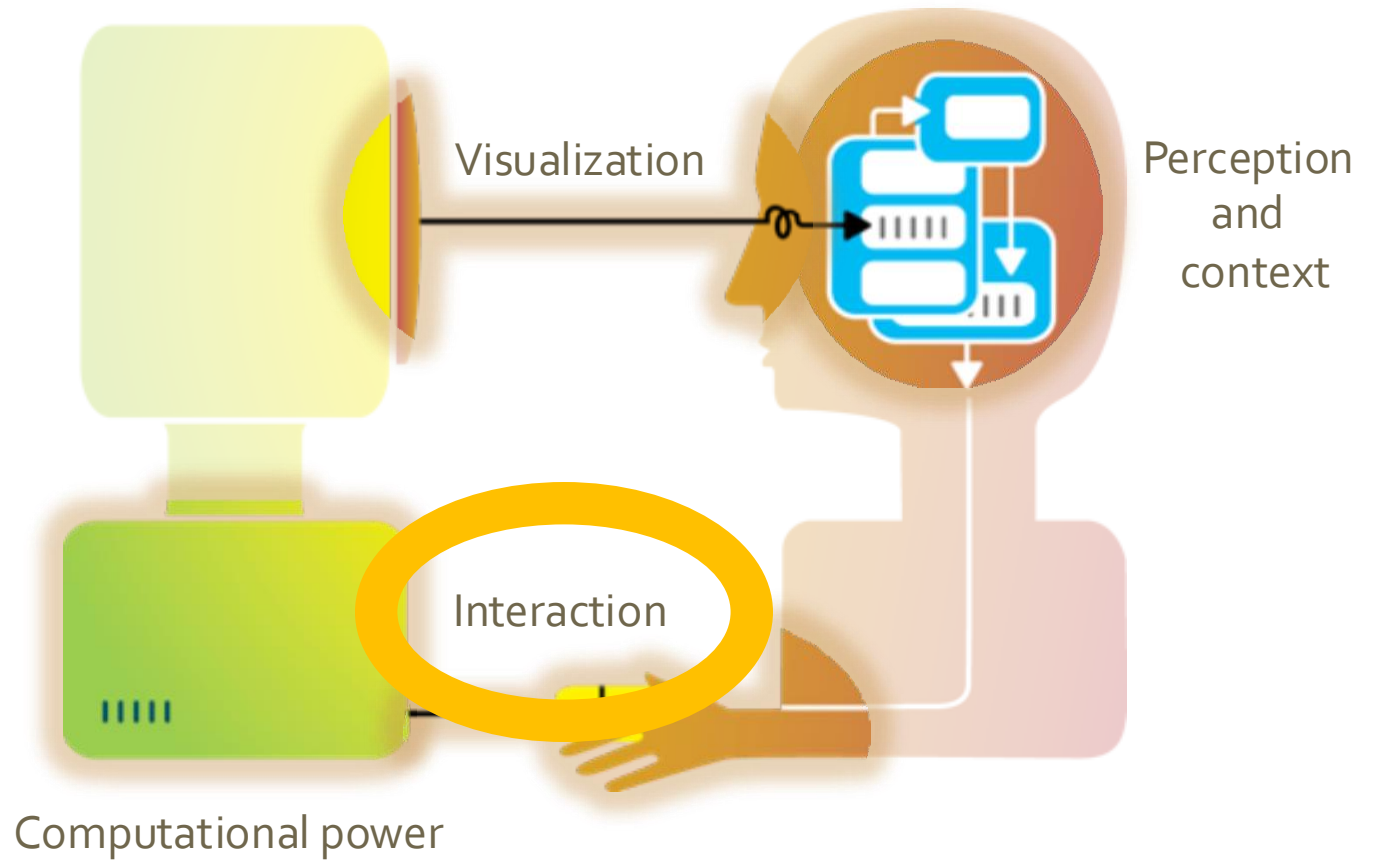


Image credit: Ali Ansari

Interaction (def.)

“Interaction for visualization is the interplay between a person and a data interface involving a data-related intent, at least one action from the person and an interface reaction that is perceived as such.”

Mandatory Components

- Interplay
- Person
- Data Interface
- Action
- Action-Reaction
- Reaction Perceived as Such
- Data-Related Intent

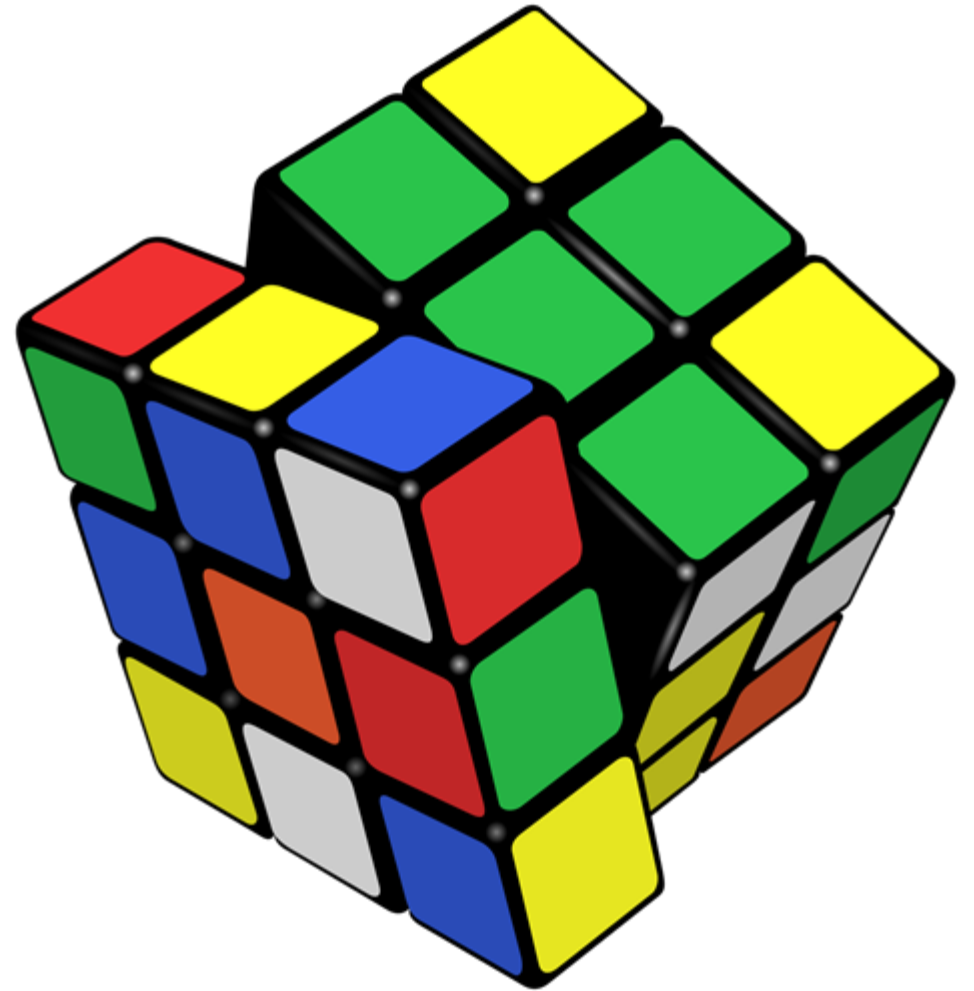
Interaction

- Methods by which humans **create knowledge** through the manipulation of an interface
- Low level: **between human and interface**
 - the set of operations available
 - the relationship between the human and the visualization
- High level: between **human and problem space**
 - a cognitive act *enabled* by the tool
 - does not need to take place exclusively within them
 - might be distributed across multiple tools

Example: Rubik's Cube

What **low-level**
interactions can you
have?

What **high-level**
interactions can you
have?



Part I: High Level

Interaction with
Data / Problem Space

Brehmer and Munzner (2013)

- *High-level* interactions with a visualization correspond to *analysis tasks*
- We can think about *why* users perform tasks (interactions) at different levels of specificity
 - High – consume vs. produce
 - Mid – search
 - Low – query

Consume vs. Produce

- Consume
 - Learn
 - Read a data story; be guided through a series of cognitive operations
 - Discover
 - Generation and verification of hypotheses, associated with models of scientific inquiry
 - Enjoy
 - Casual encounters with visualization
 - User is not driven by a need to verify or generate a hypothesis; novelty stimulates curiosity and exploration
- Produce
 - Generate
 - Create new artifacts such as transformed or derived data, annotation, recorded interactions, screenshots

Search

- Process of the user finding elements of interest in the visualization
- Search is categorized based on:
 - If the target of the search is known a priori
 - If the location of the target is known a priori

	Target Known	Target Unknown
Location known	User is familiar with American geography and looking for CA on a choropleth map	User using a tree visualization is searching within a specific subtree for leaf nodes having few siblings
Location Unknown	User is unfamiliar with American geography and looking for CA on a choropleth map	User is searching for outliers in a scatterplot

Query

- Once a target or set of targets has been found a user may
 - Identify
 - Returns characteristics about the target
 - Ex. User of a choropleth map *identifies* the margin of victory for the winning election candidate in CA
 - Compare
 - Refers to multiple subsets of targets
 - Ex. User of a choropleth map identifies election results for CA and *compares* them to results for MA
 - Summarize
 - Refers to a whole set of targets
 - Ex. User of a choropleth map *summarizes* election results across all states

the targets

Part II: Low Level

Interaction with
a Visual Interface

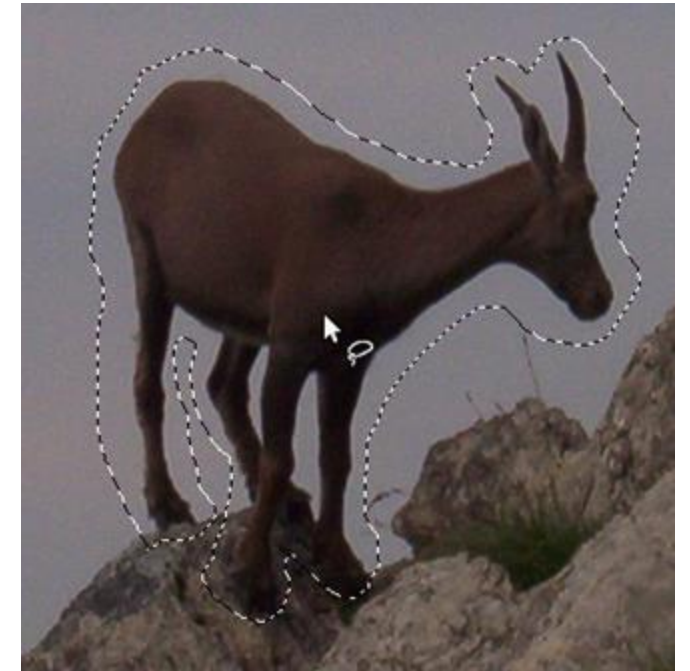
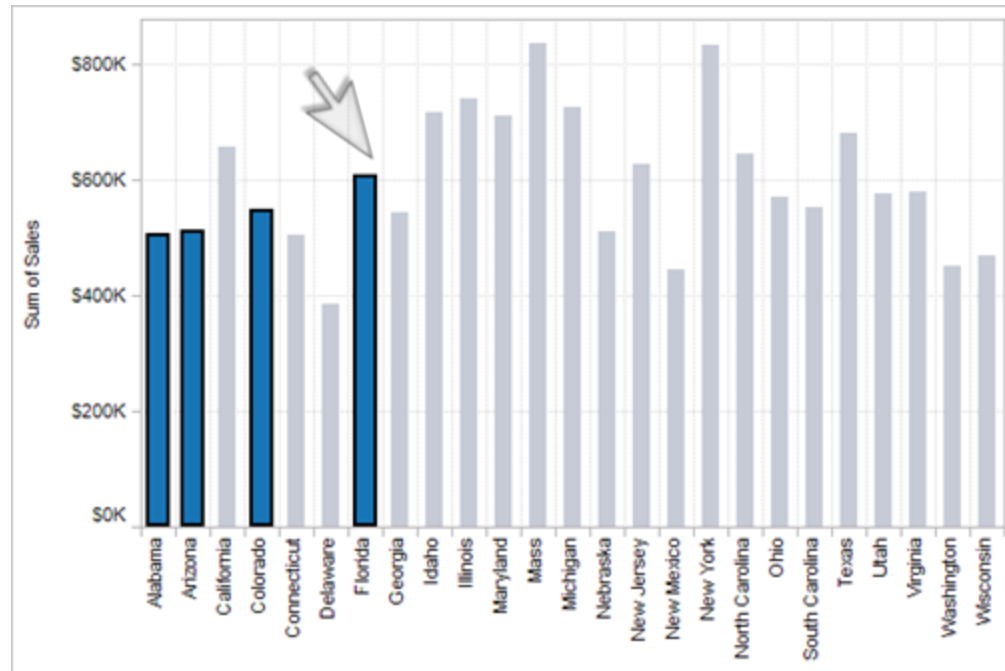
Yi, Kang, Stasko and Jacko (2007)

1. Select: mark something as interesting
2. Explore: show me something else
3. Reconfigure: show me a different arrangement
4. Encode: show me a different representation
5. Abstract/Elaborate: show me more or less detail
6. Filter: show me something conditionally
7. Connect: show me related items

Yi, J. S., Kang, Y., Stasko, J. T., & Jacko, J. A. (2007). Toward a deeper understanding of the role of interaction in information visualization. *Visualization and Computer Graphics, IEEE Transactions on*, 13(6), 1224-1231.

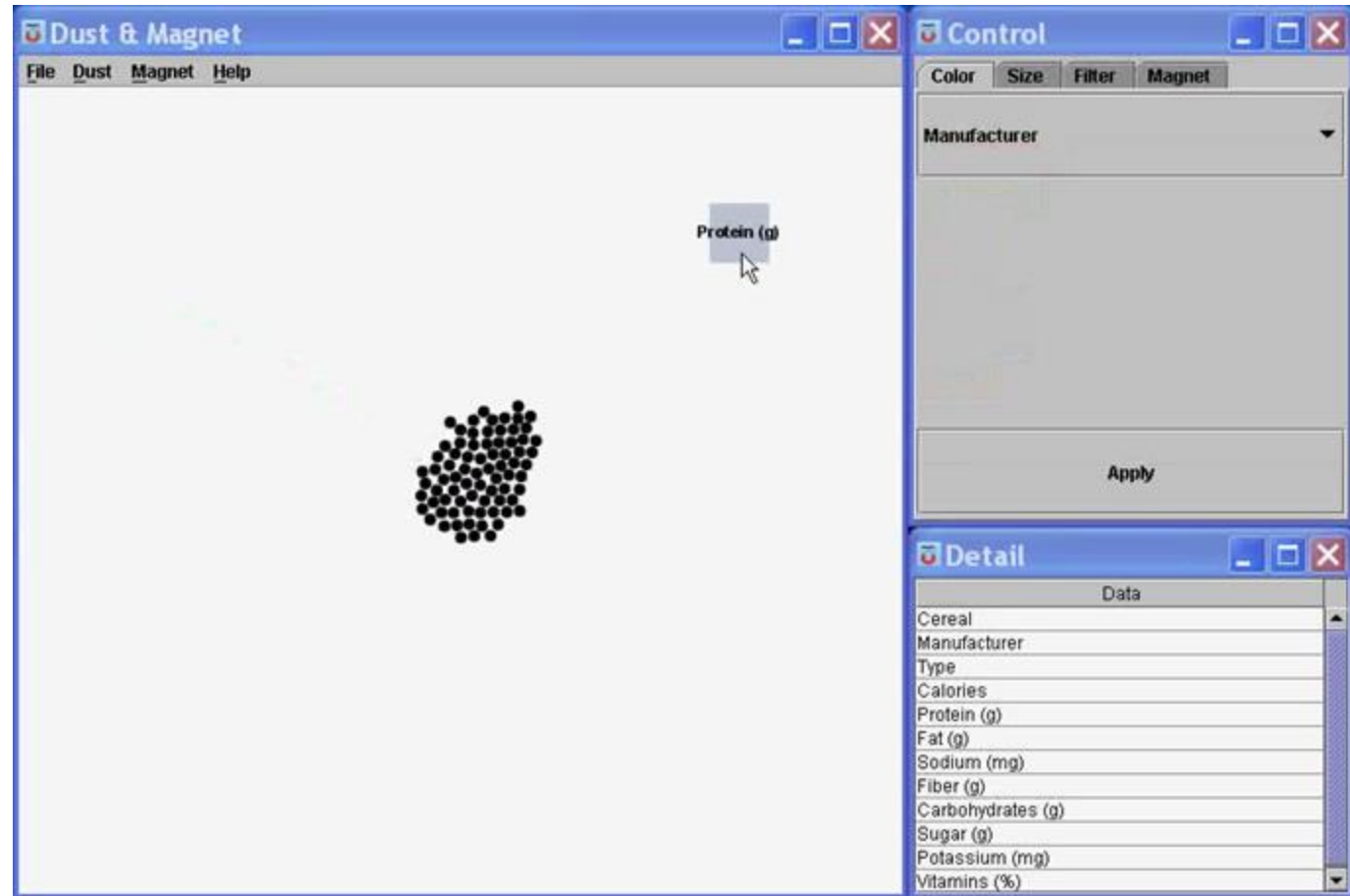
1. Select

Mark something as interesting: direct



Mark something as interesting: indirect

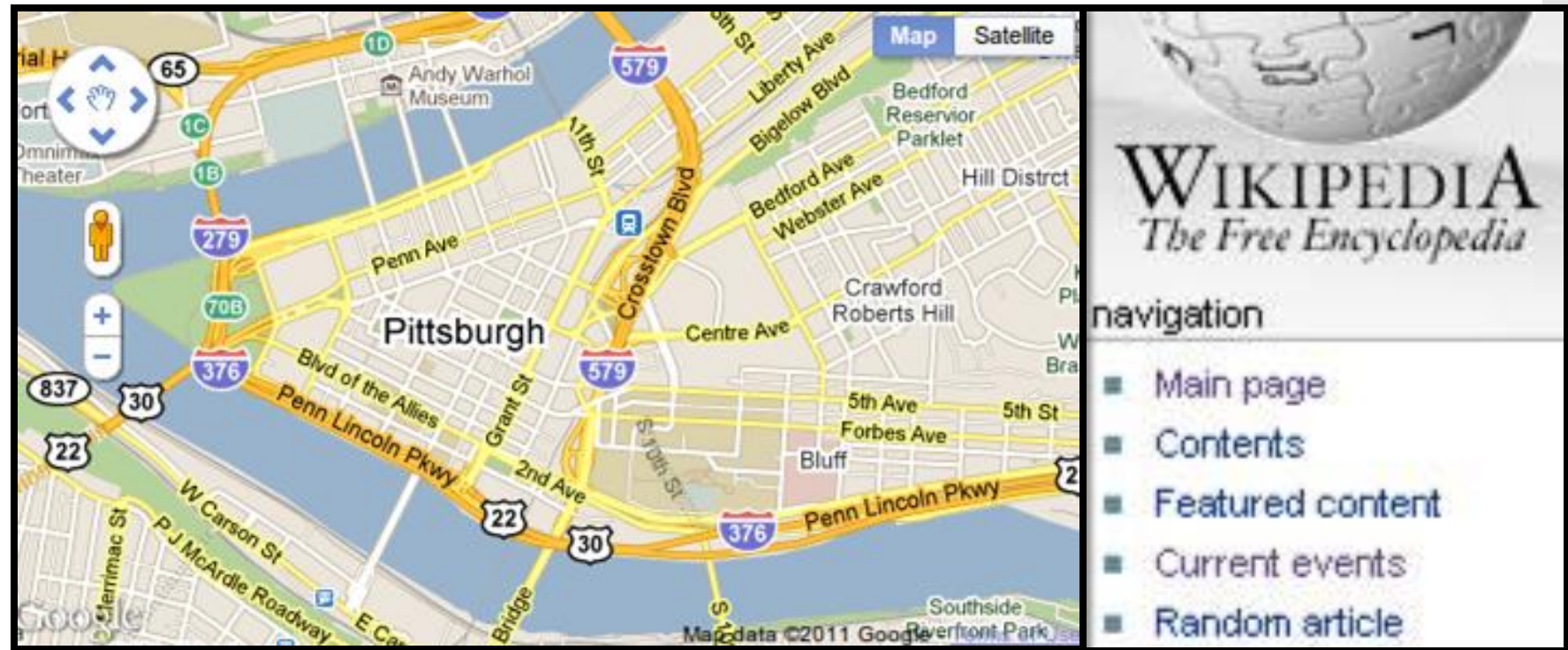
1. Select



2. Explore

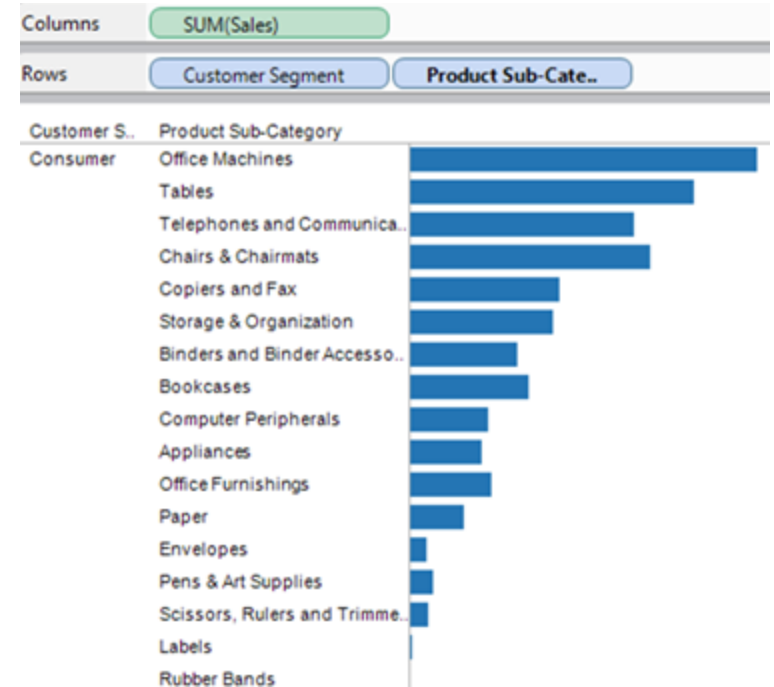
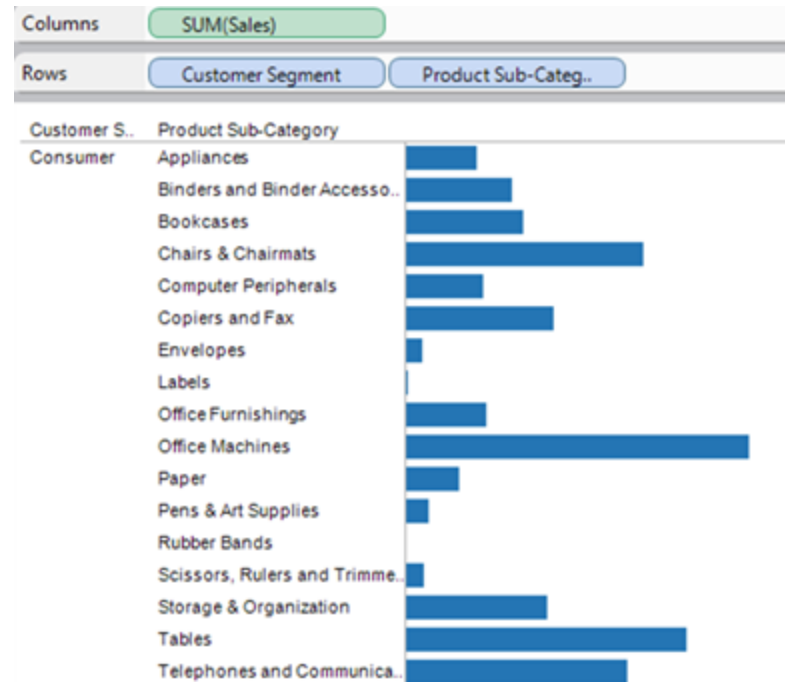
Show me something else

- Scroll bars
- Panning
- Direct-Walk (e.g. hyperlink traversal)



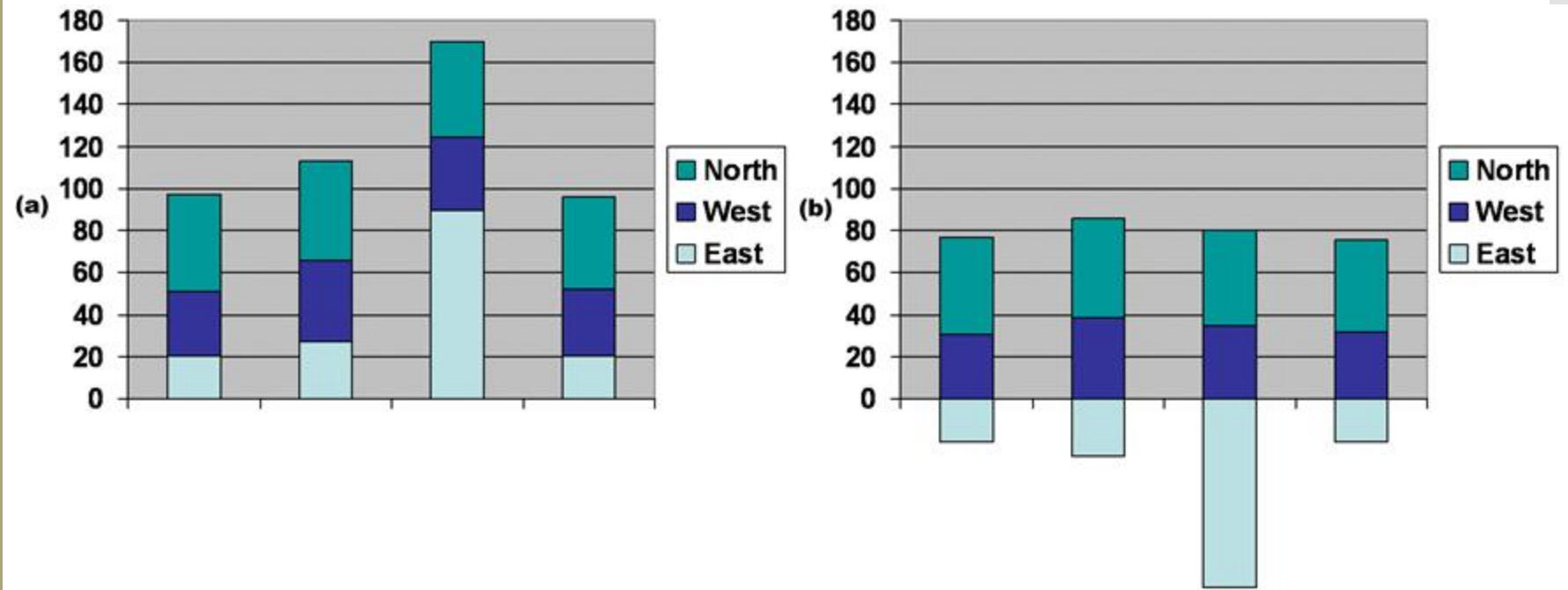
3. Reconfigure

Show me a different arrangement: sorting



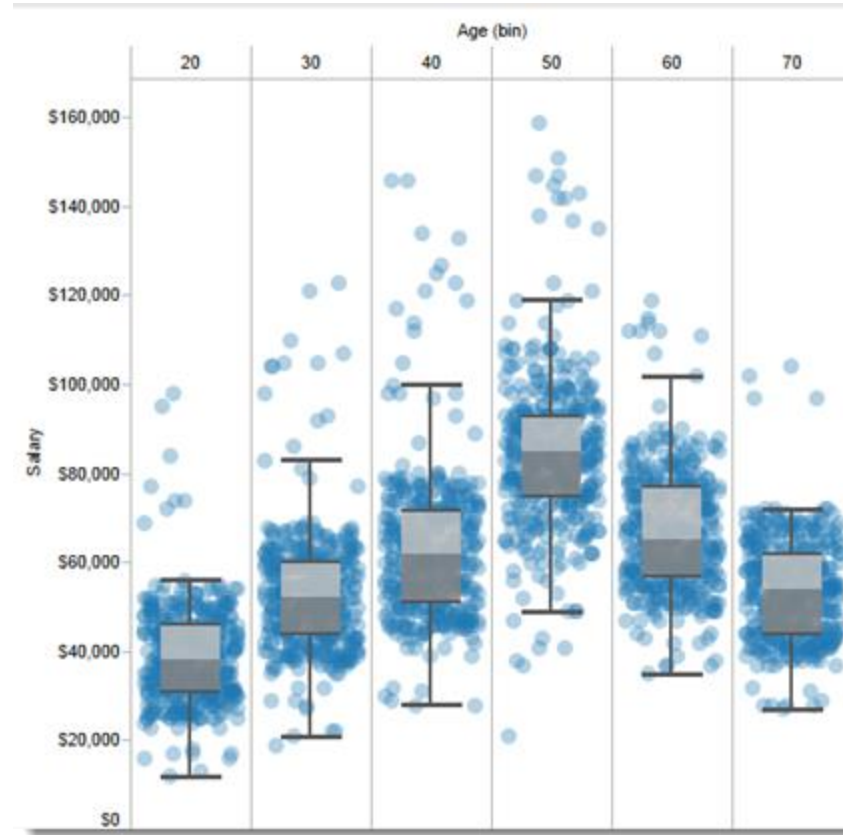
3. Reconfigure

Show me a different arrangement: baseline adjustment



3. Reconfigure

Show me a different arrangement: reduce occlusion (jitter)



4. Encode

Show me a different representation: visualization type, color, size, orientation, etc.



5. Abstract / Elaborate

Show me more or less detail: drill up/down



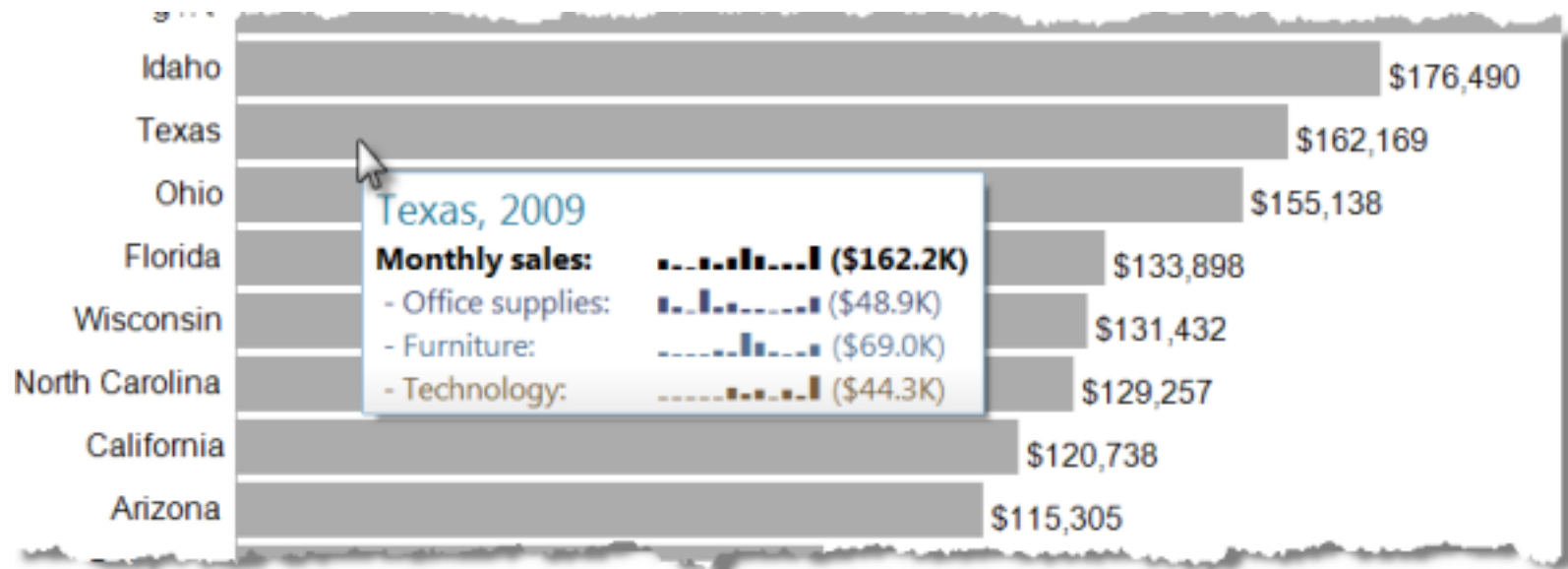
5. Abstract / Elaborate

Show me more or less detail: zooming



5. Abstract /
Elaborate

Show me more or less detail: tooltips



6. Filter

Show me something conditionally

NameVoyager: Explore baby names and name trends letter by letter

Looking for the perfect baby name? [Sign up for free](#) to receive access to our expert tools!

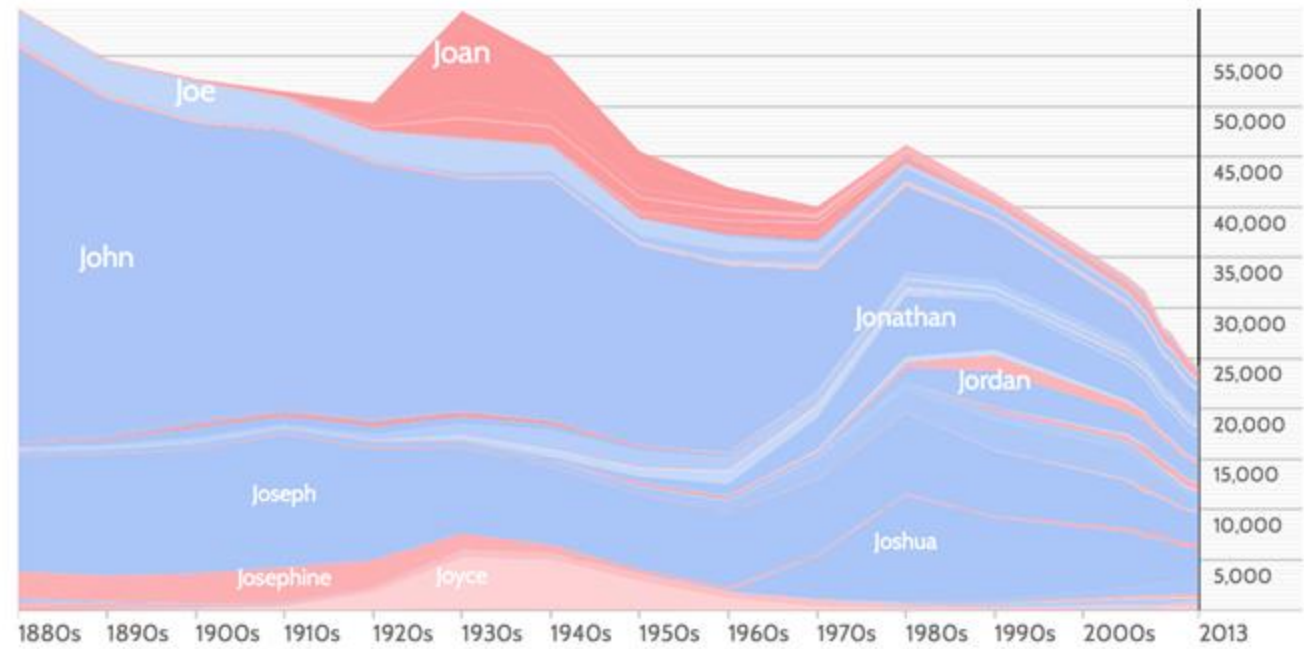
Baby Name > ☒ Both ☐ Boys ☐ Girls

boys	1000	500	100	25	1
girls	1000	500	100	25	1

Current rank:

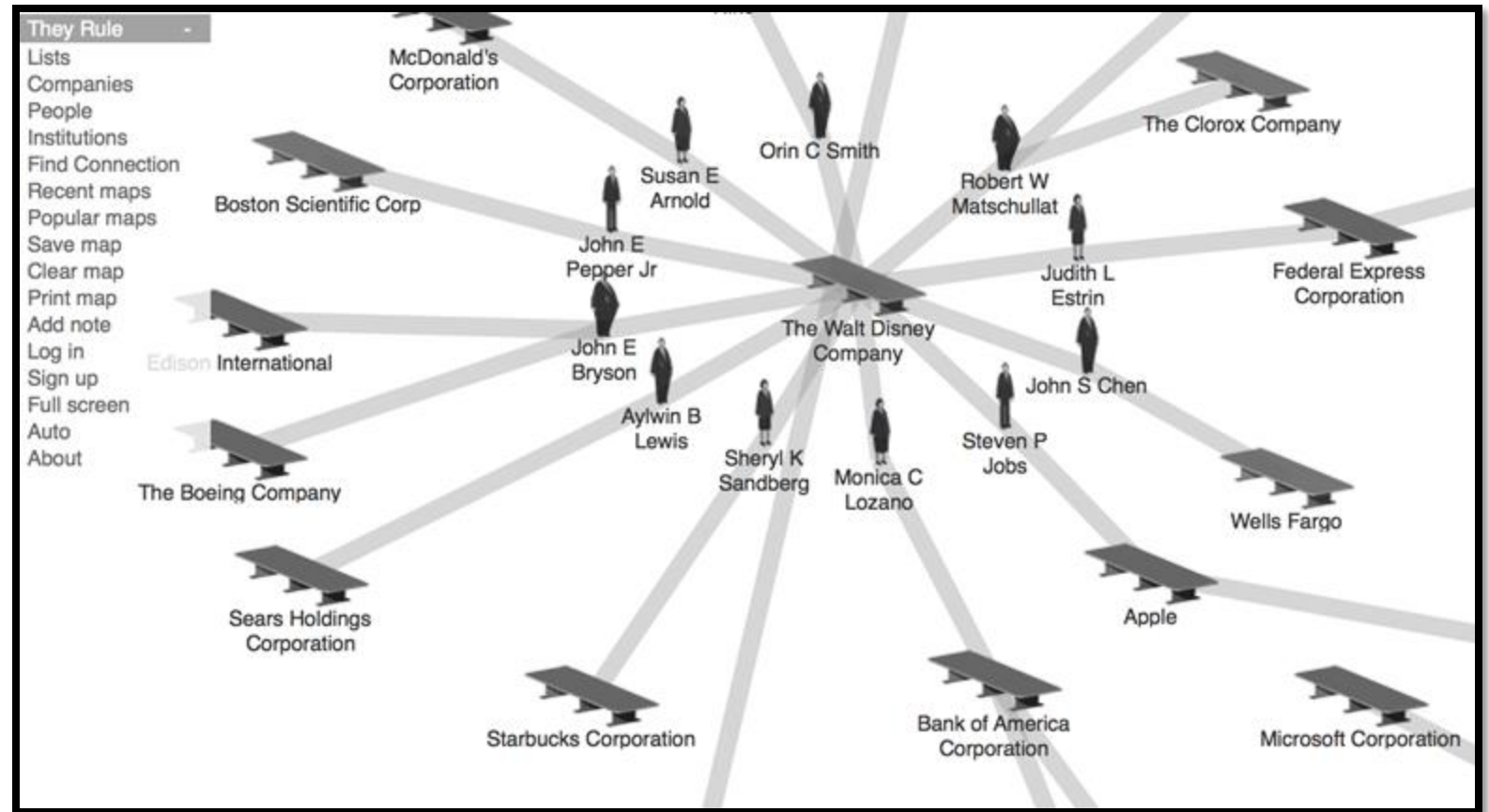
Names starting with 'JO' per million babies

per million births



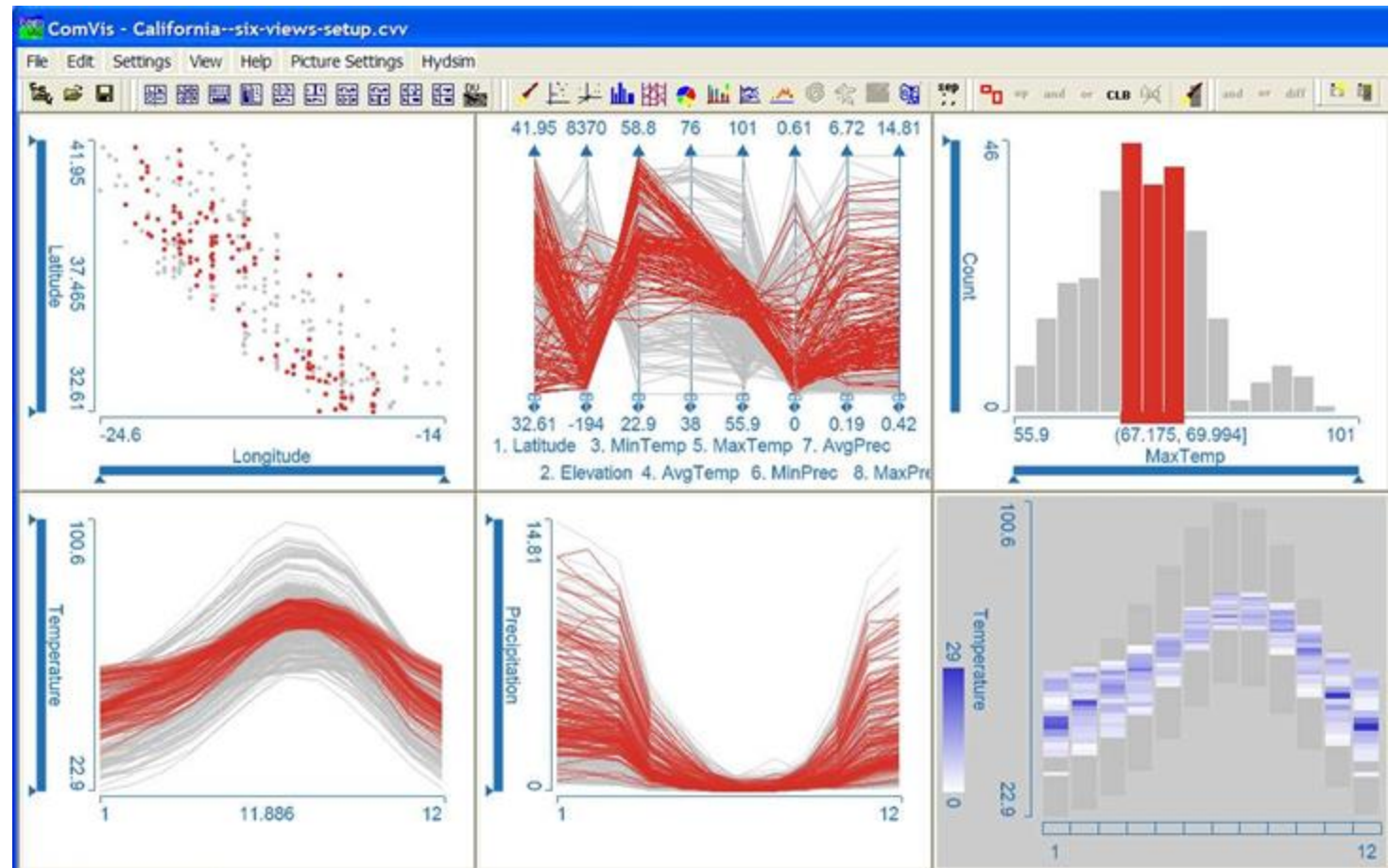
7. Connect

Show me related items: build-out

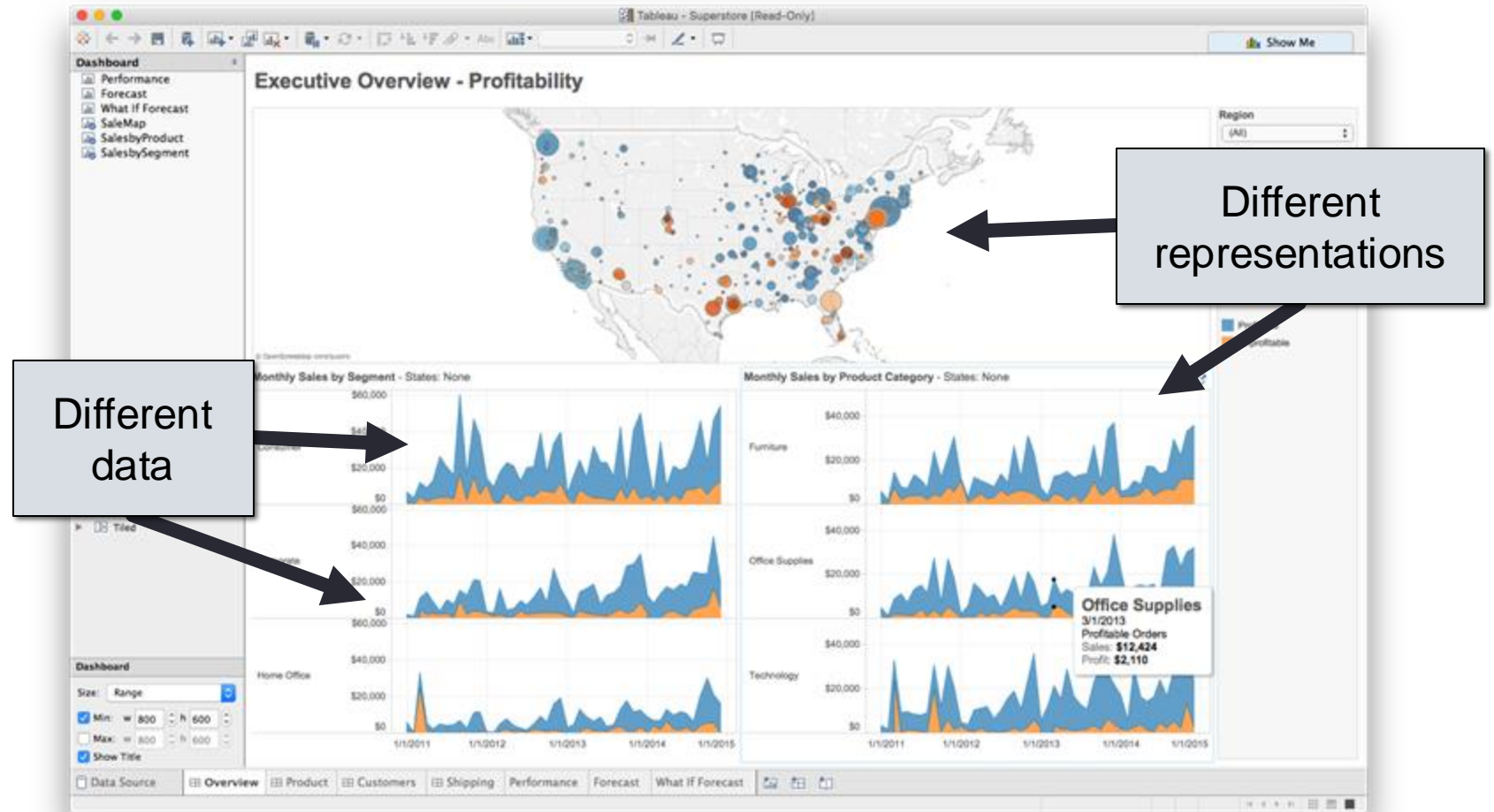


7. Connect

Show me related items: coordinated multiple views (CMV)



Multiple views



Systems that use **two or more distinct views** to support the exploration of a single concept or domain

Suggested questions to ask when designing

1. What is the goal of the analysis?
 - Decision-making
 - Better understand a domain or a problem
 - Identify the trends of a phenomenon
 - Forecast the future
 - ...etc.
2. What kinds of operations do we need to enable?
3. How can the visualization support those operations?

Demo: coordinated multiple views

Tableau CMV walkthrough and exploration