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

Congrats on an exceptional job on the Mid-semester Project! I'm super proud of the work you did, and I hope you all are, too!

Announcements

- Smith Office for the Arts (SOFA) is accepting proposals for the McConnell Foyer Gallery
- I think a visualization installation would be a great fit for the space. If you'd like to brainstorm and submit a proposal with me, please reach out on Slack

Do Plants Know Math?: Unwinding the Story of Plant Spirals from Leonardo to Now

BUS: A Teacher in Transit

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

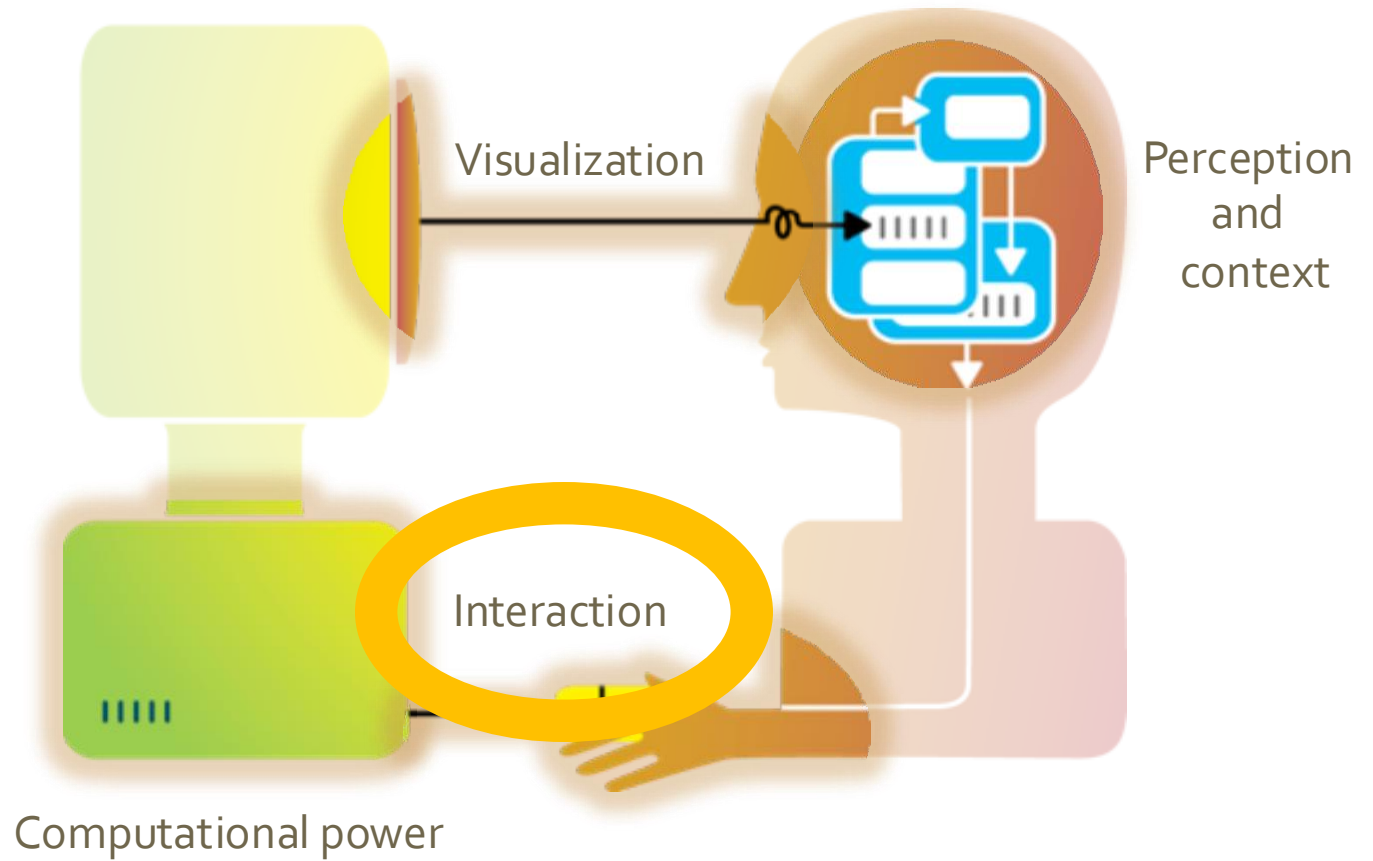## Humans and machines have **complimentary strengths**

Visualization

Perception and context

Interaction

Computational power

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

What is Interaction for Data Visualization? Evanthia Dimara, Charles Perin. 2020

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?
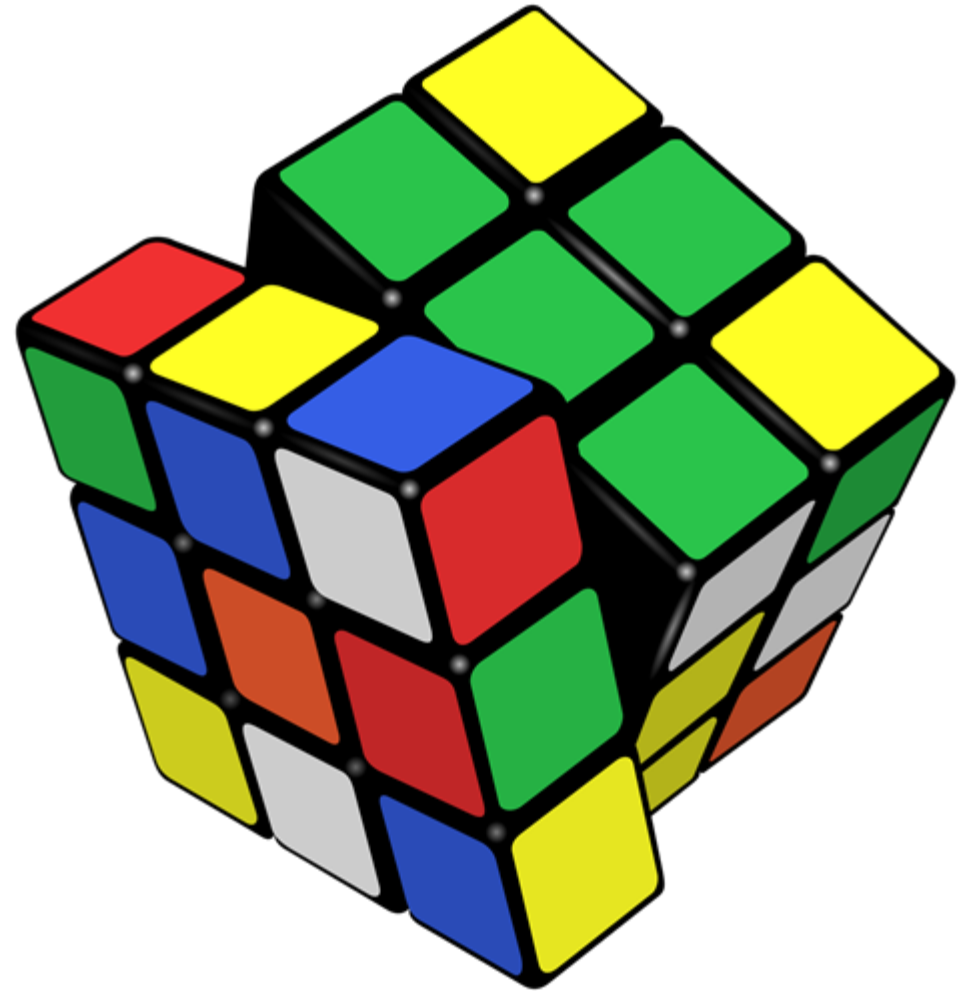
Part I: High Level

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., ah 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
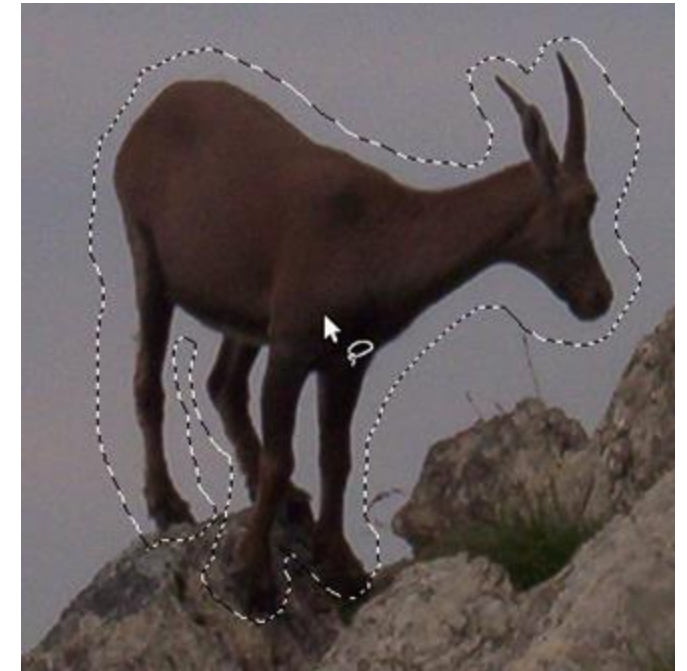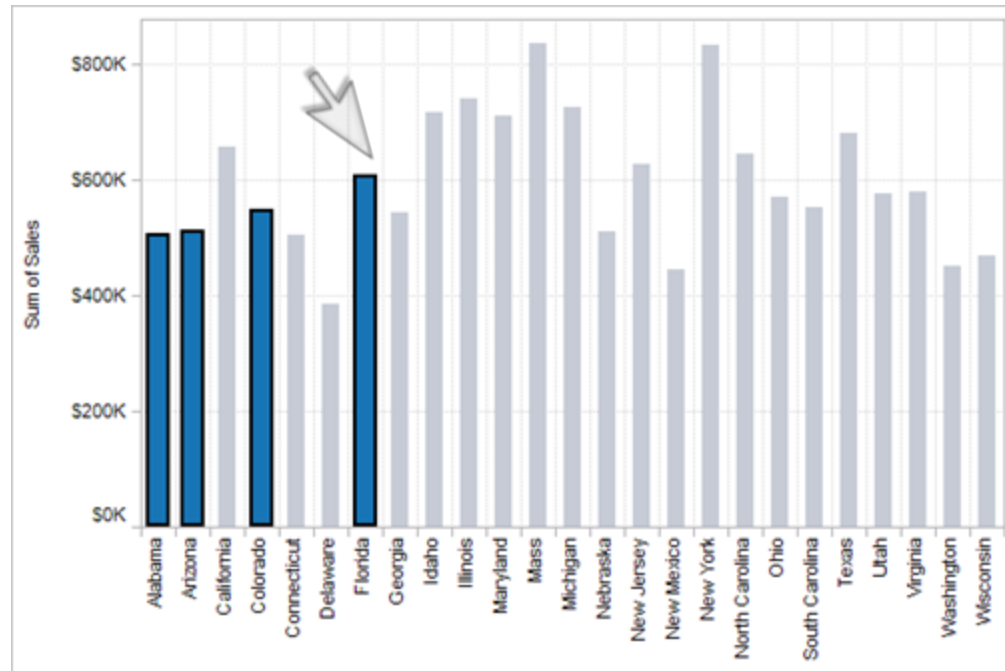
1. Select

Mark something as interesting: indirect
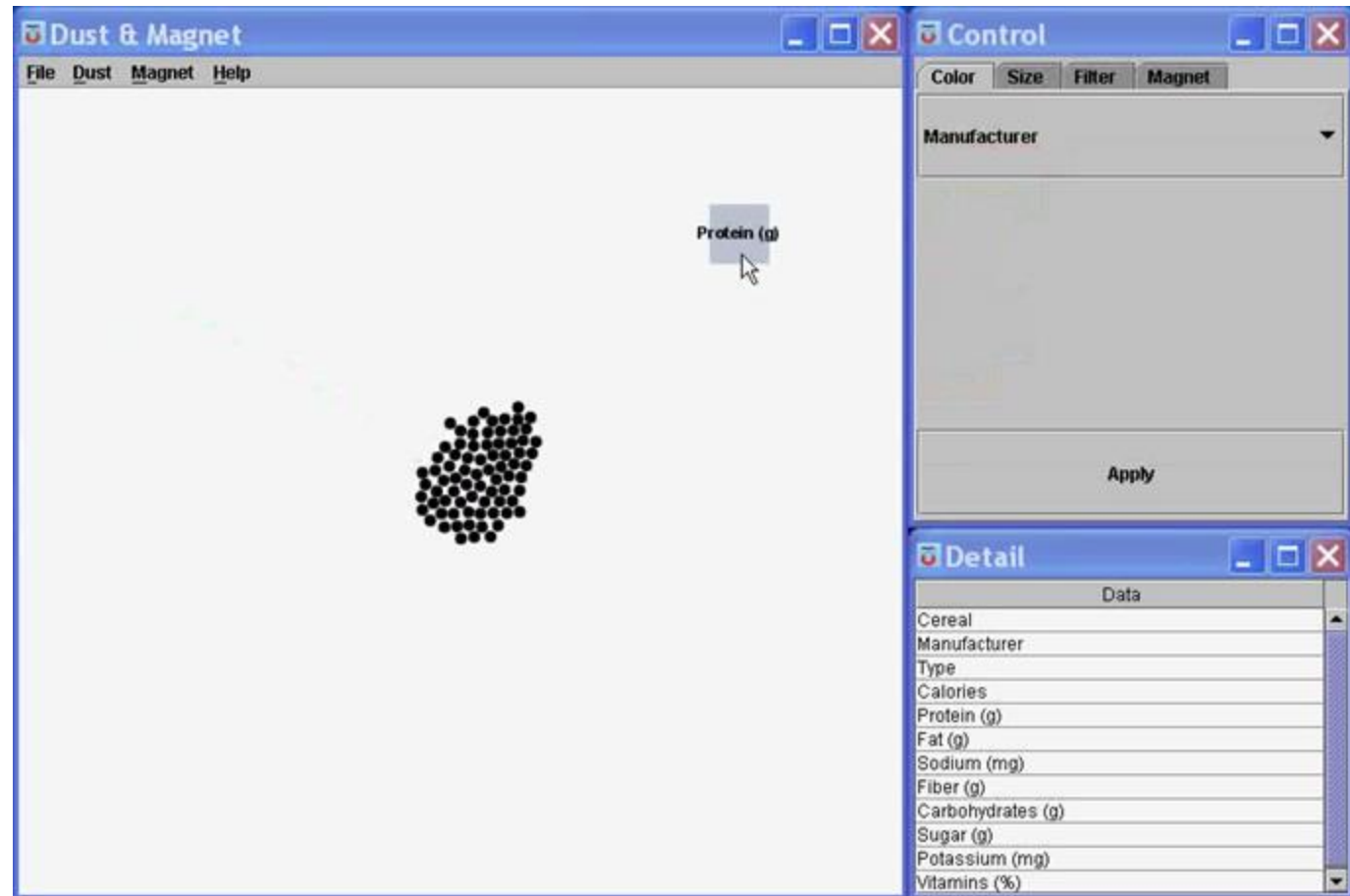
2. Explore

Show me something else
- Scroll bars
- Panning
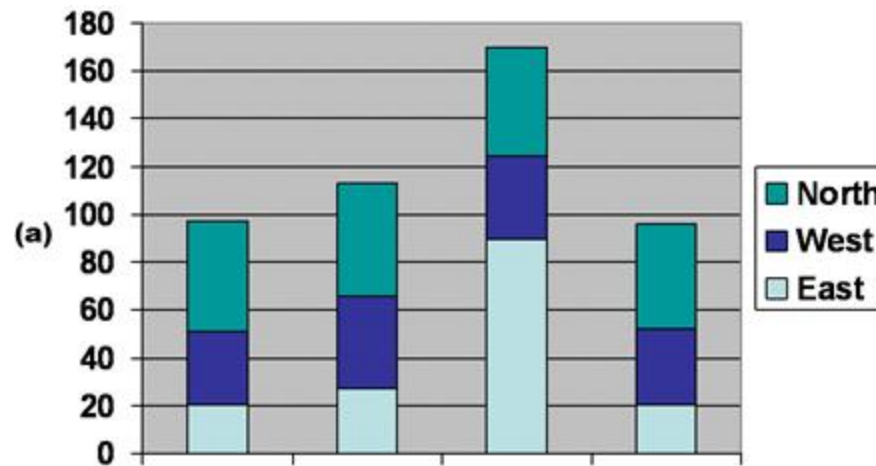- Direct-Walk (e.g. hyperlink traversal)
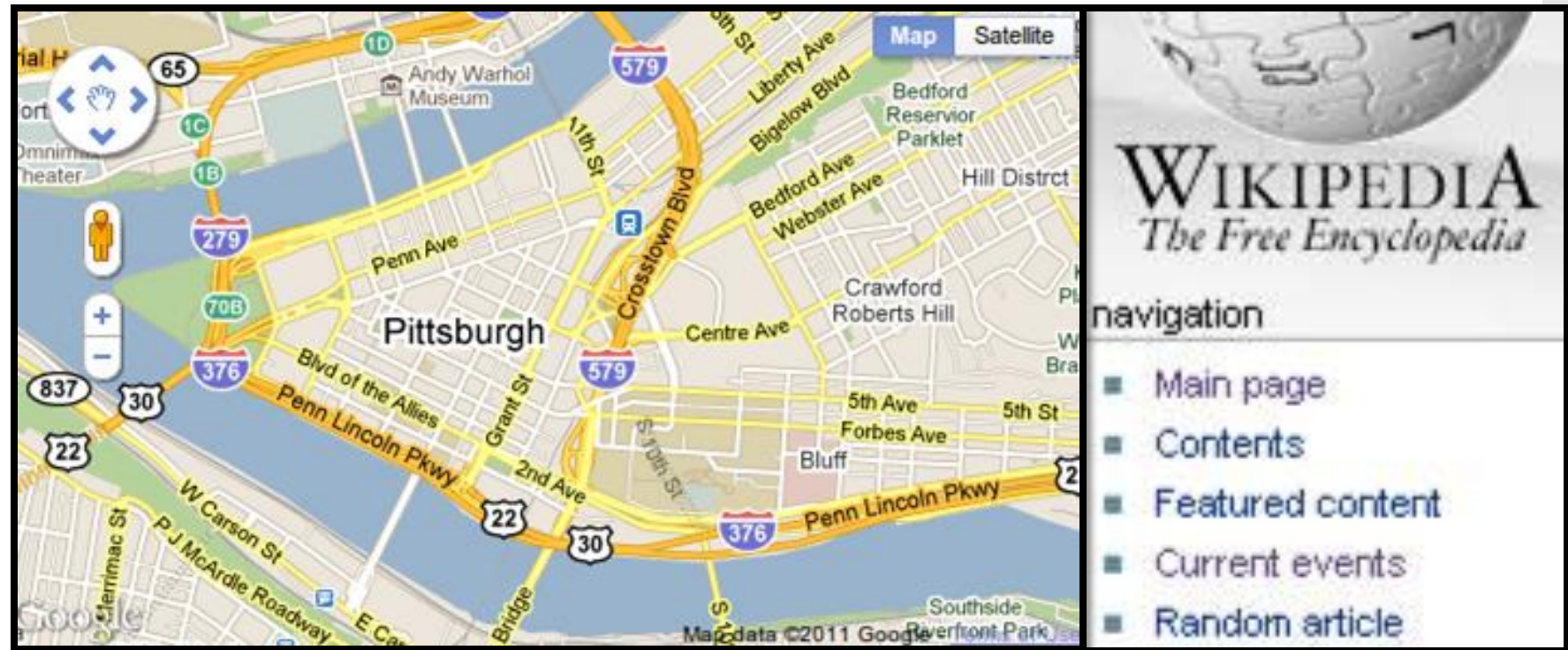
3. Reconfigure

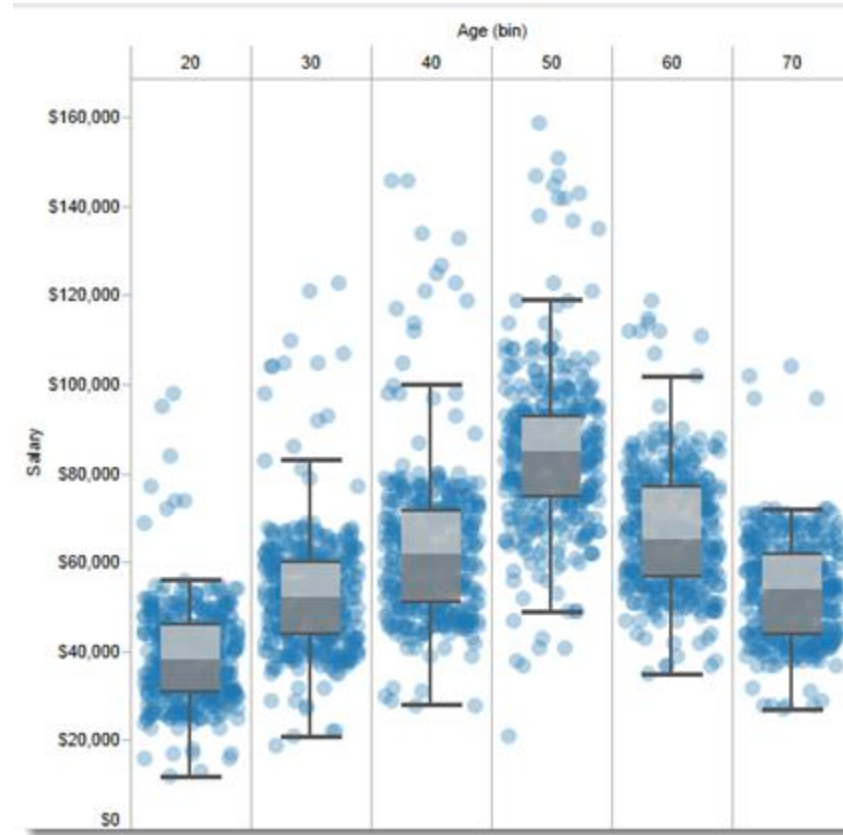Show me a different arrangement: sorting
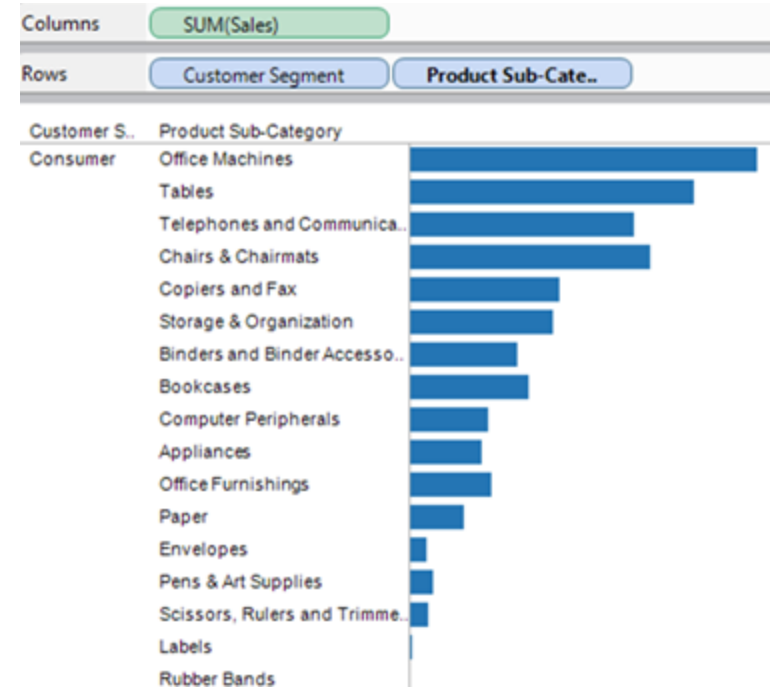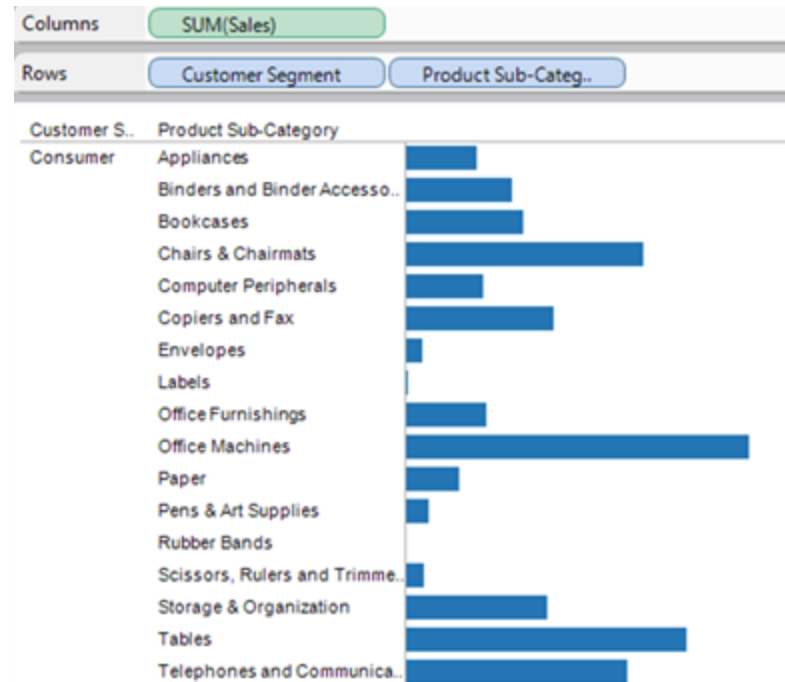
3. Reconfigure

Show me a different arrangement: baseline adjustment
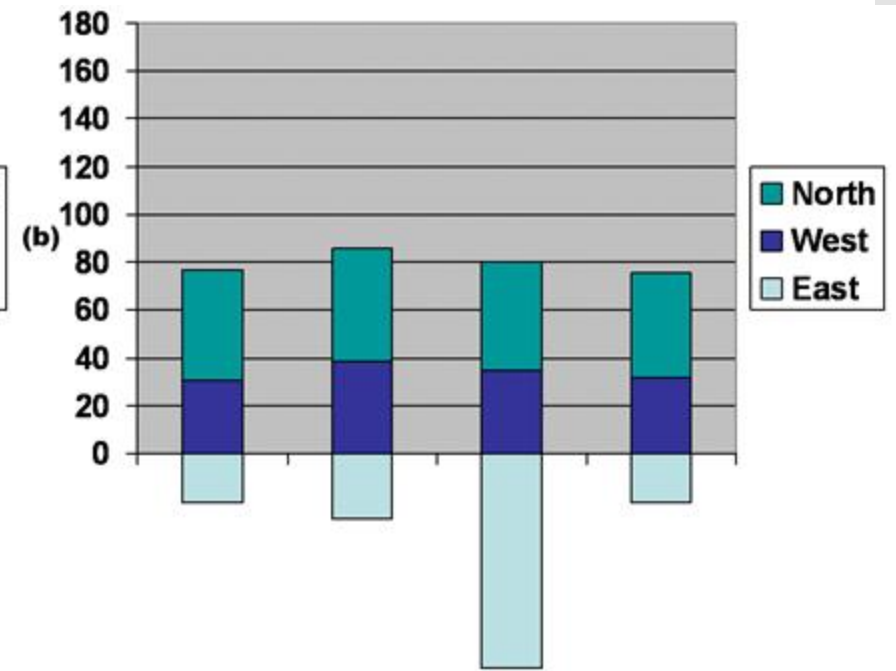
3. Reconfigure
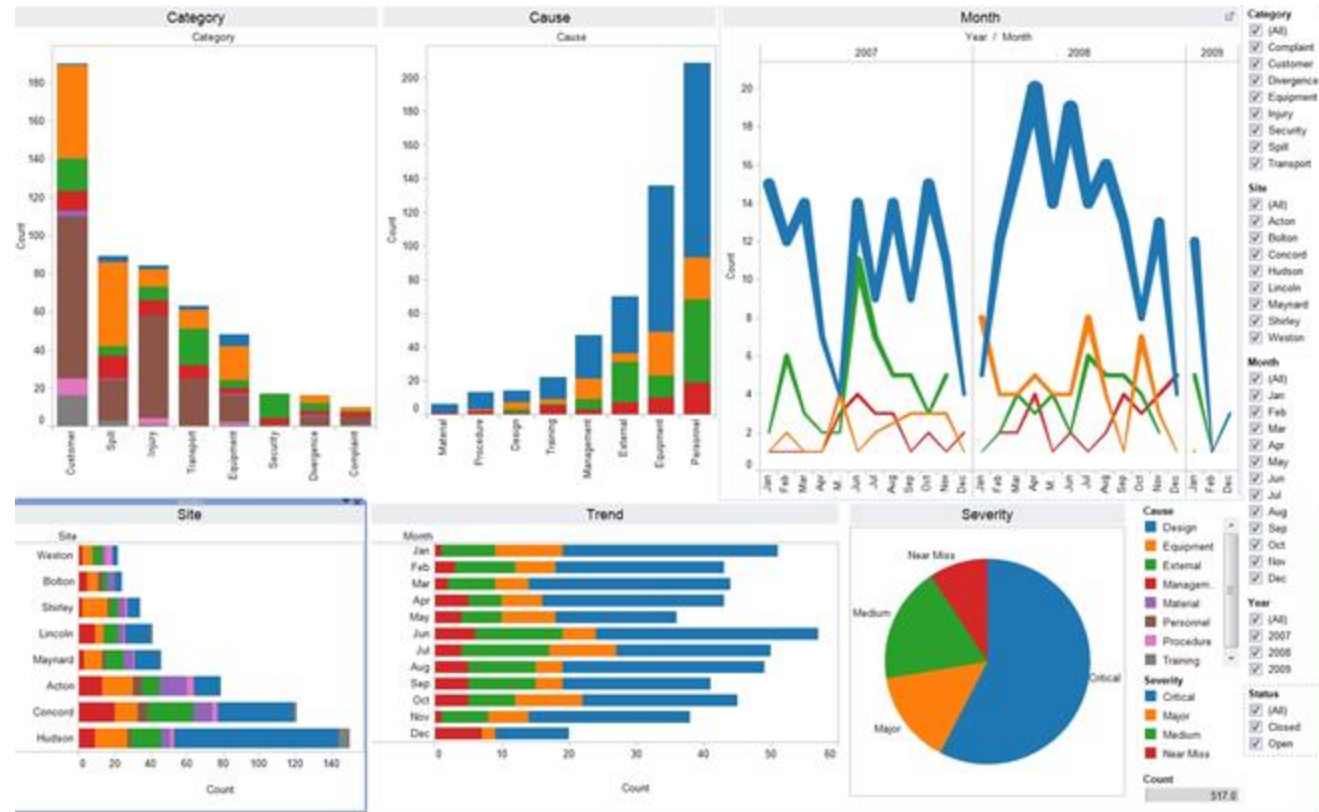
Show me a different arrangement: reduce occlusion (jitter)

4. Encode

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

5. Abstract / Elaborate

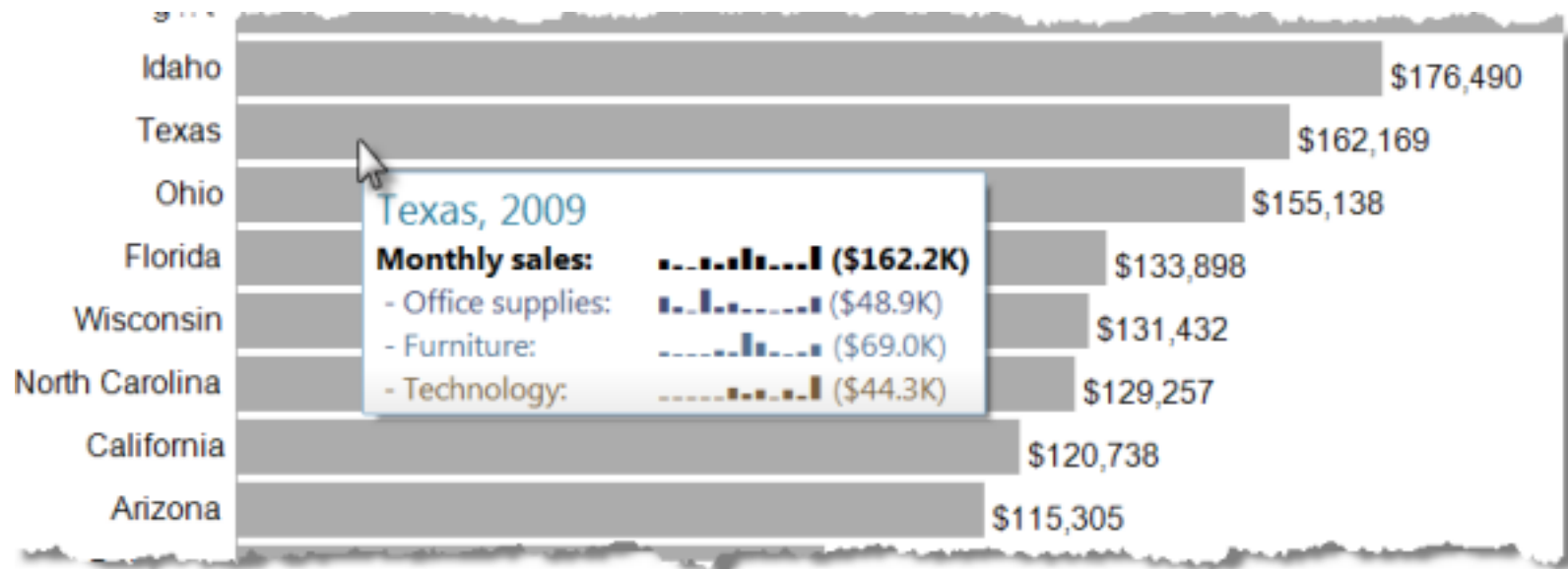Show me more or less detail: drill up/down

5. Abstract / Elaborate

Show me more or less detail: zooming

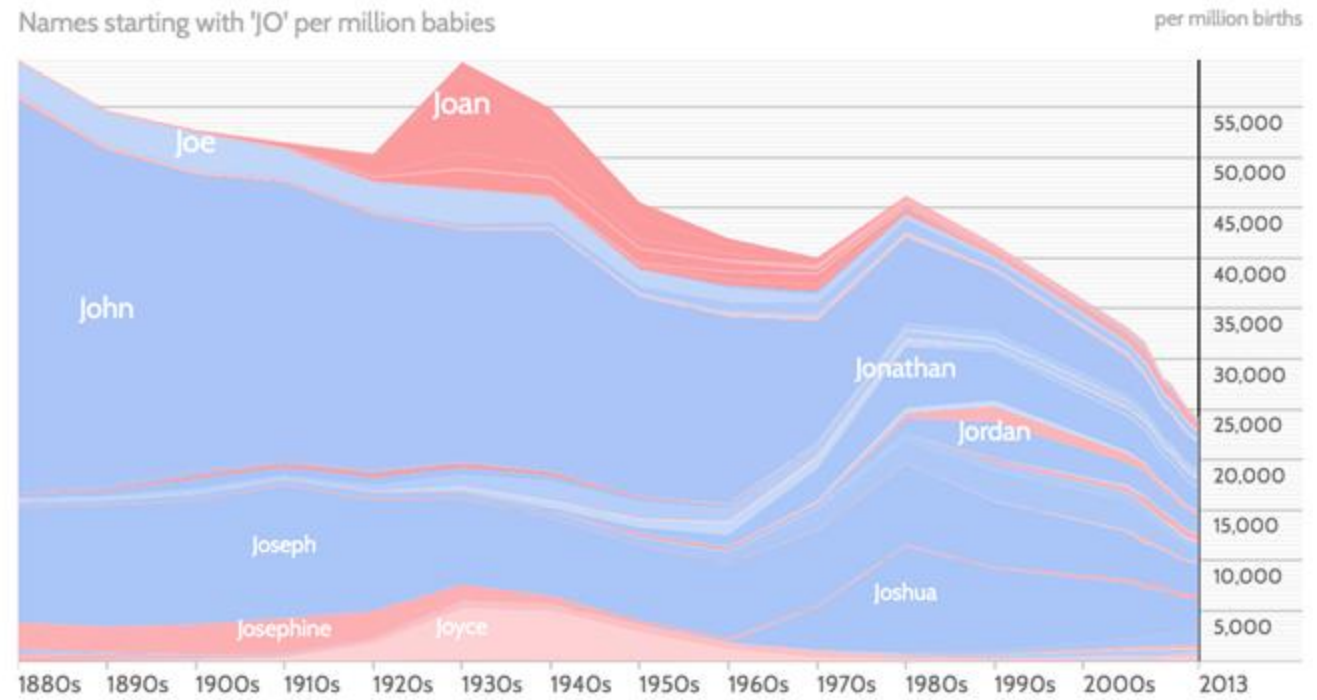# 5. Abstract / Elaborate

Show me more or less detail: tooltips

6. Filter

Show me something conditionally
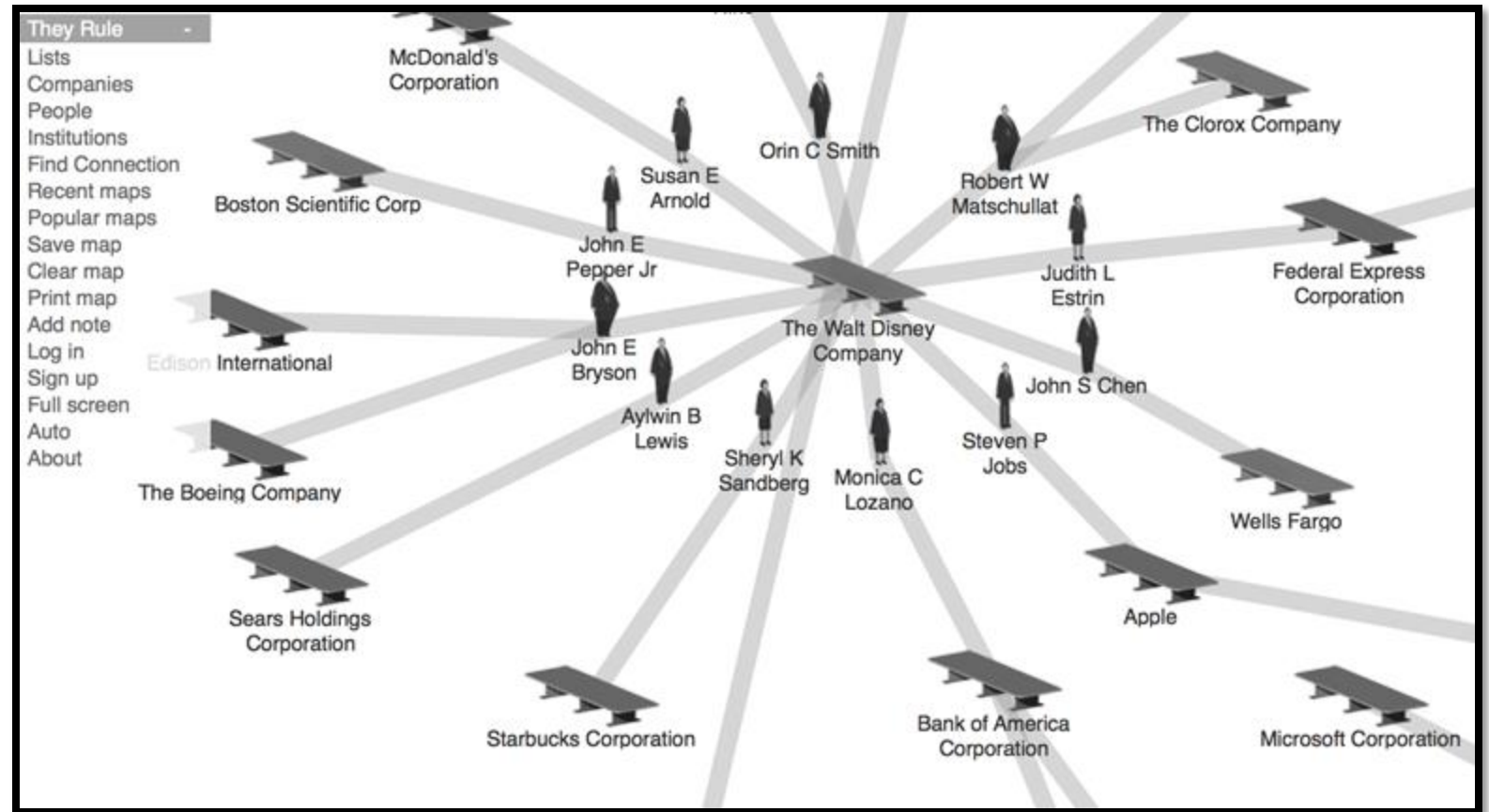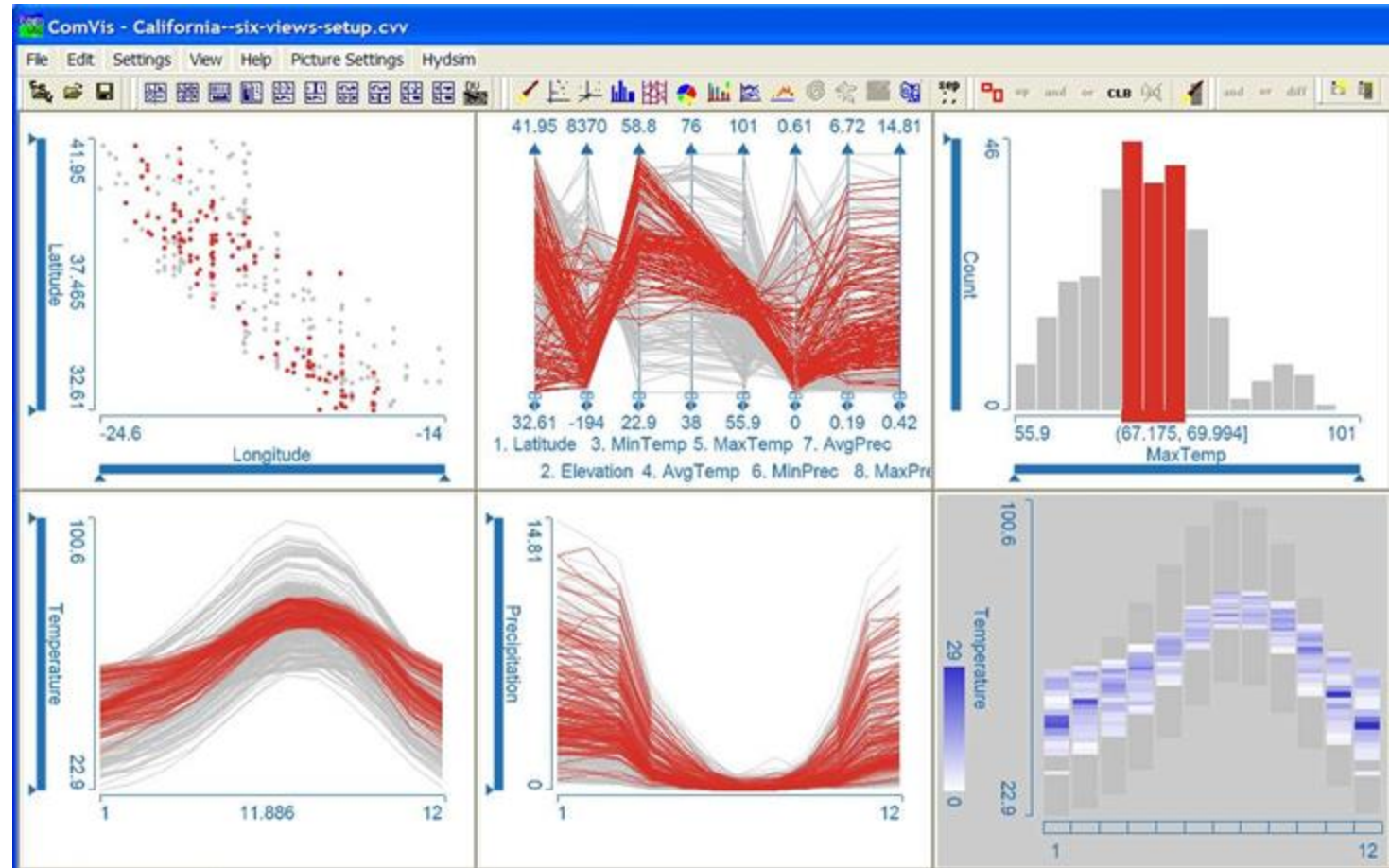
7. Connect
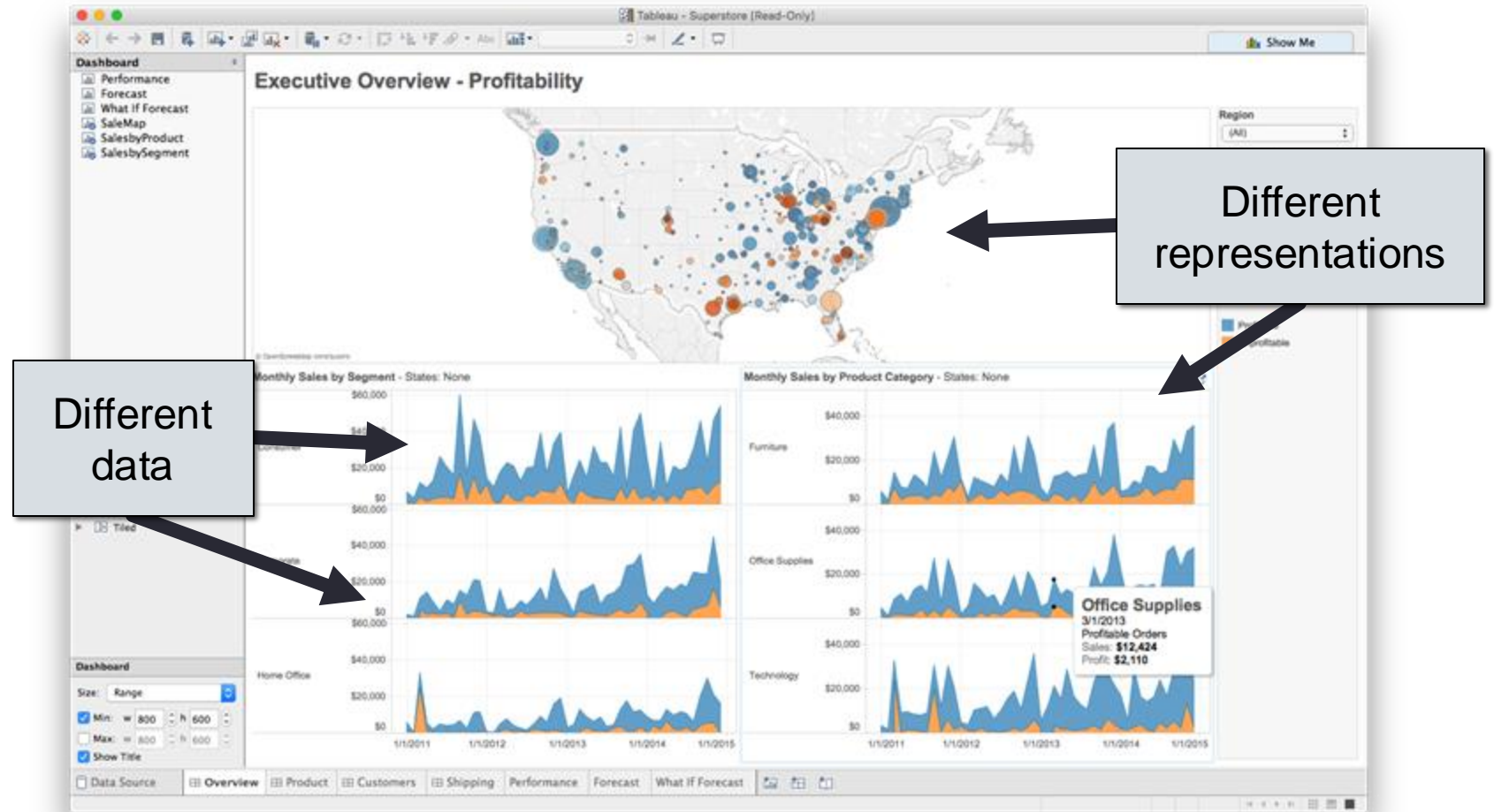
Show me related items: build-out

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