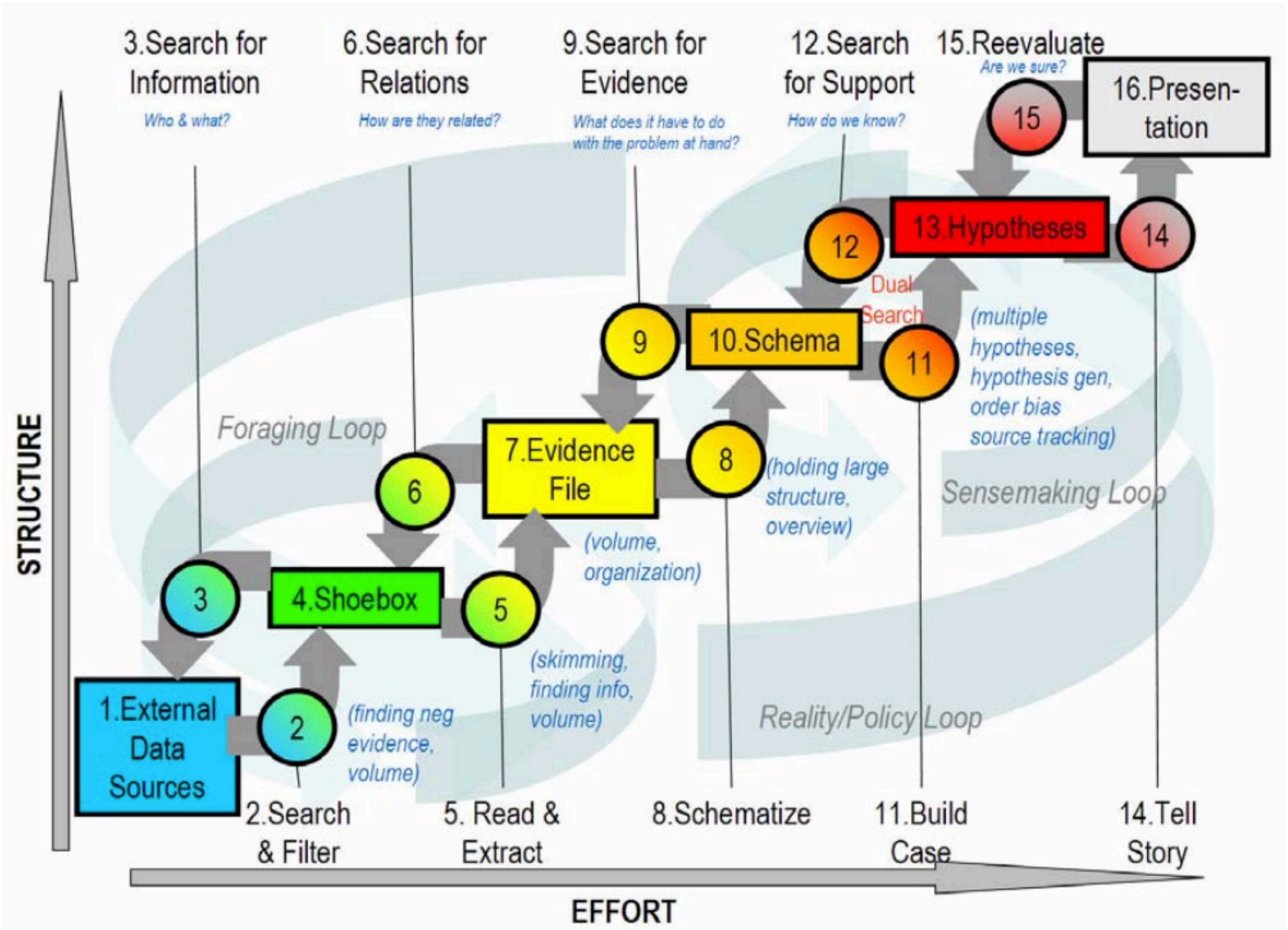
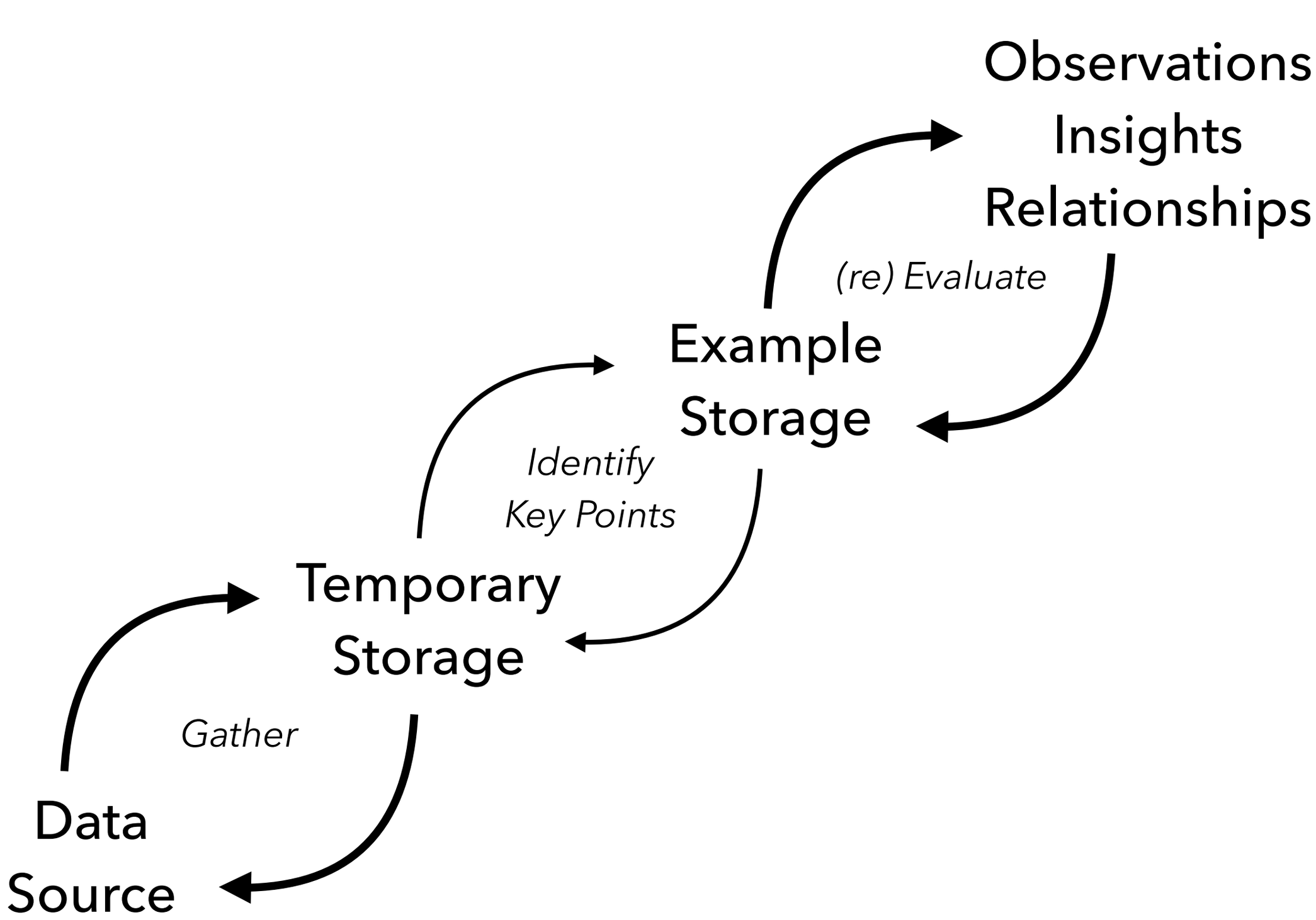
Interaction

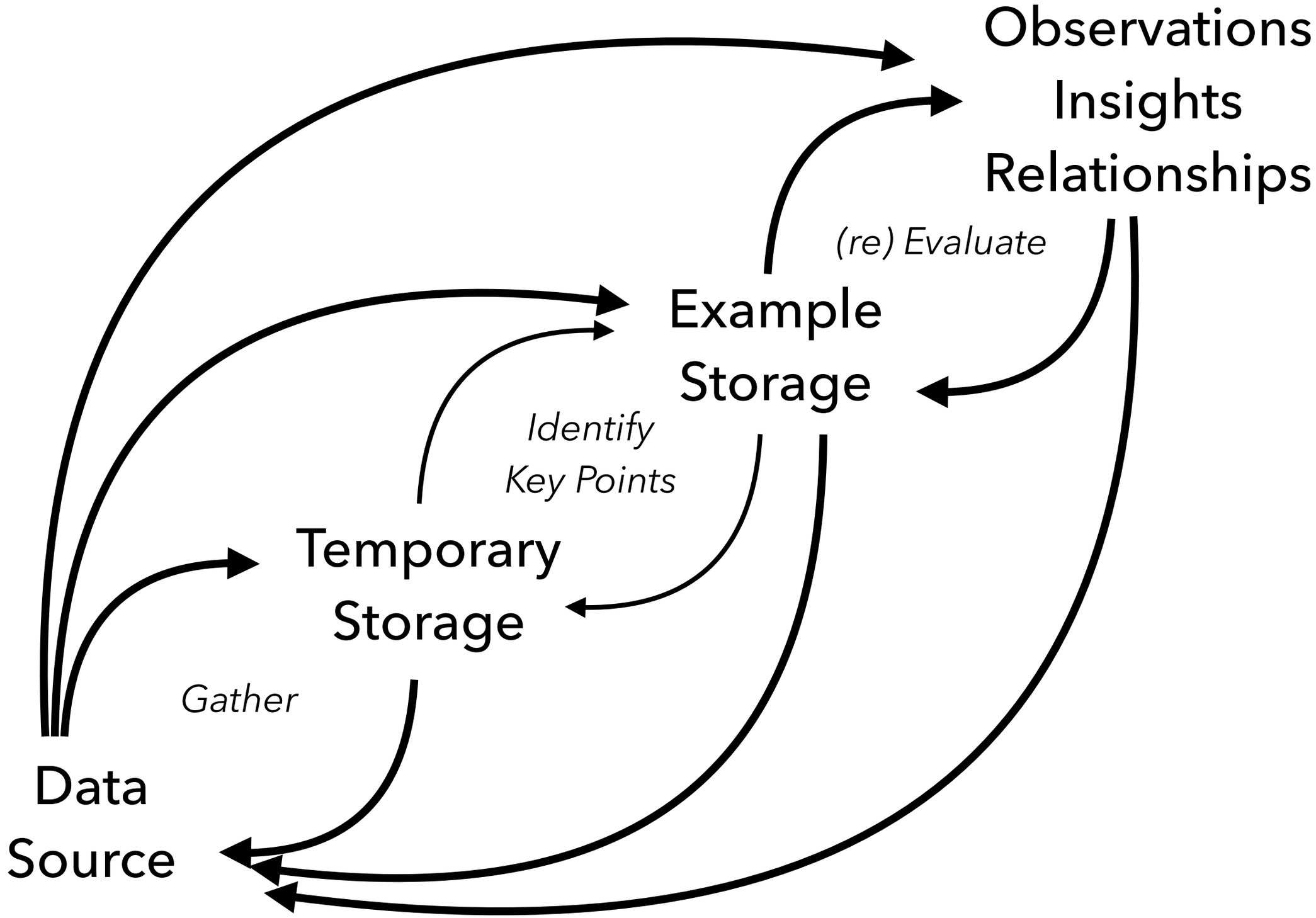
Why do we need interactive data vis?



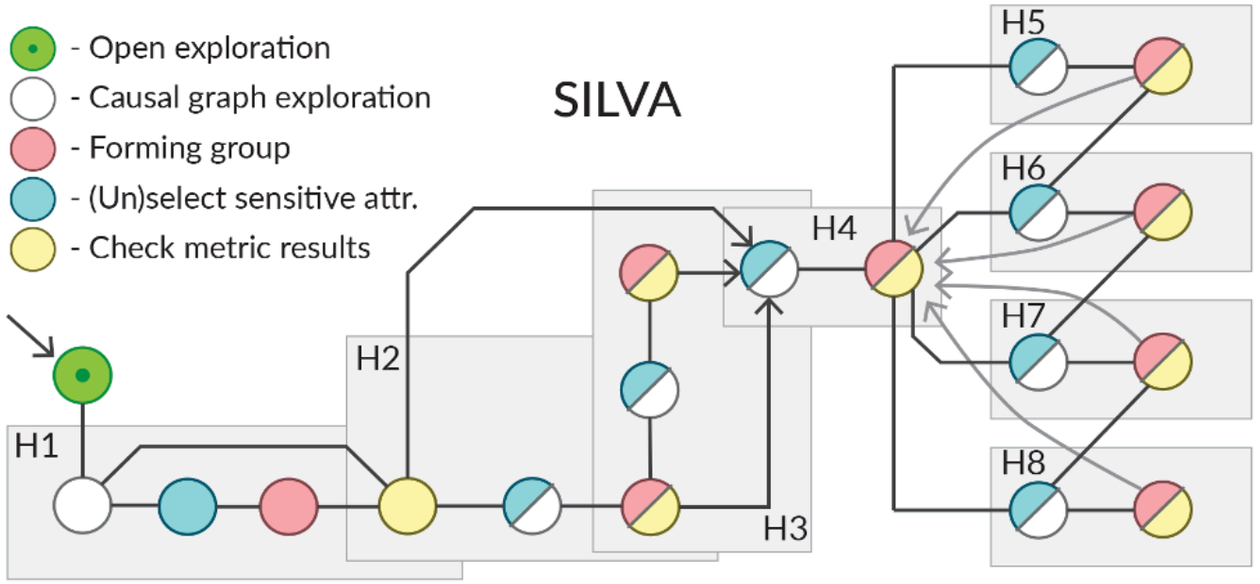
Pirolli, P. and Card, S. K. 2005.
The sensemaking process and leverage points for analyst technology. Intl. Conference on Intelligence Analysis.

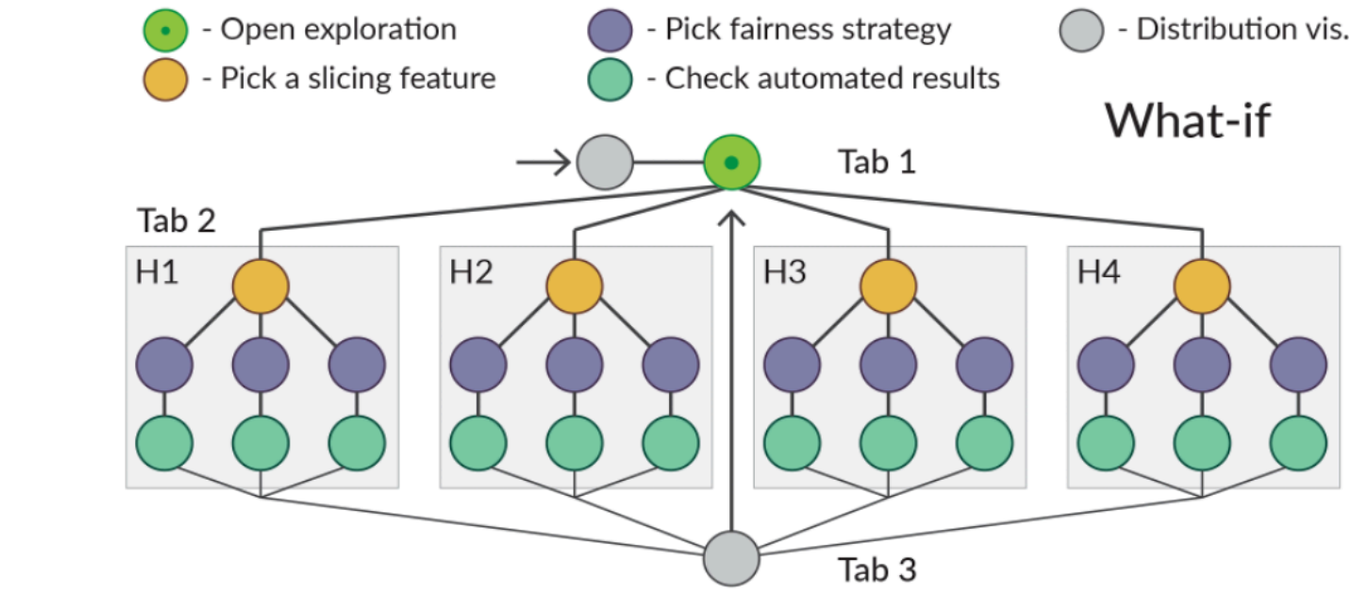


Pirolli, P. and Card, S. K. 2005.
The sensemaking process and leverage points for analyst technology. Intl. Conference on Intelligence Analysis.



Pirolli, P. and Card, S. K. 2005.
The sensemaking process and leverage points for analyst technology. Intl. Conference on Intelligence Analysis.


- Open exploration
- Causal graph exploration
- Forming group
- (Un)select sensitive attr.
- Check metric results
SILVA
H1
H2
H3
H4
H5
H6
H7
H8


- Open exploration
- Pick a slicing feature
- Pick fairness strategy
- Check automated results
- Distribution vis.
What-if
Tab 1
Tab 2
Tab 3
H1
H2
H3
H4


- Check automated results
- Check metric results
AIF
H1
H2

Why interact?

Define and decompose complex actions

Spread operations across time

Working memory is limited – expand capacity

Attention is limited – direct efficiently

Screen size is limited – expand data scale

Kinds of Viz Interactions

Specify

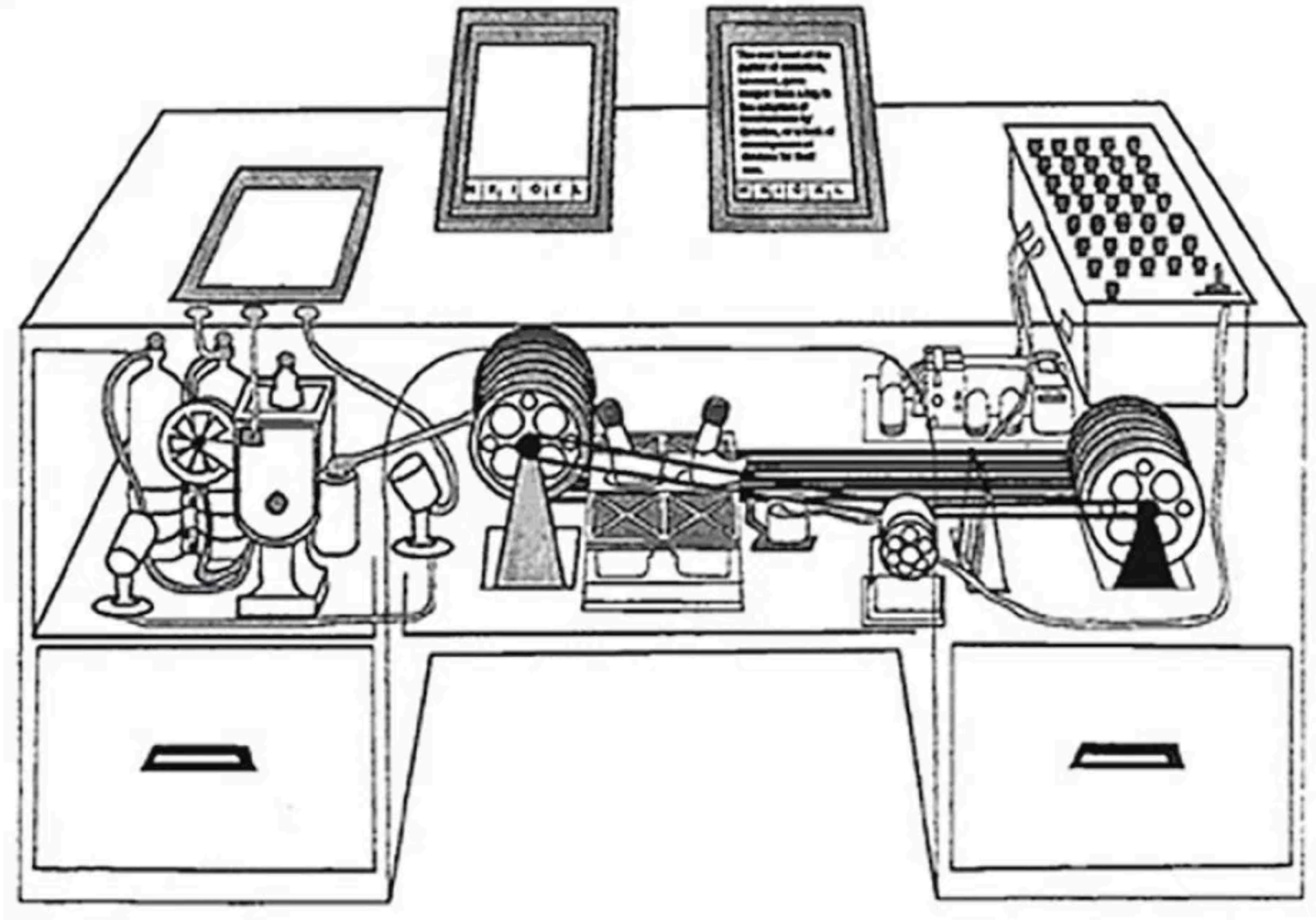
Present, Filter, Sort, Derive

Manipulate

Select, Navigate, Coordinate, Organize

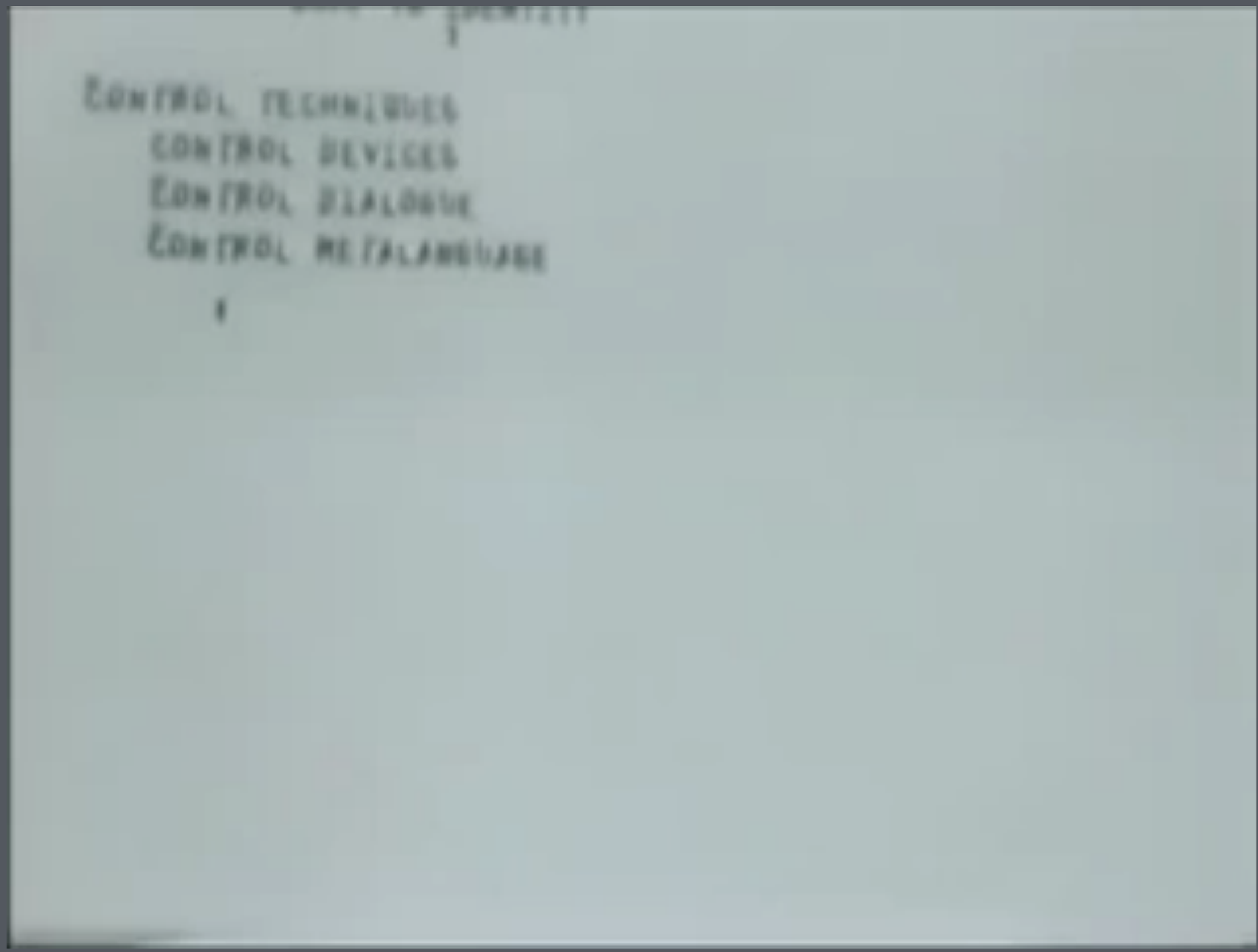
Process & Store

Annotate, Warehouse, Share



Vannevar Bush, As We May Think

Sketchpad, 1963, Ivan Sutherland
youtu.be/6orsmFndx_o



Mother of All Demos, 1968, Doug Engelbart
youtu.be/yJDv-zdhzMY

Put That There, 1979, Chris Schmandt
youtu.be/RyBEUyEtxQo

Picturing, **R**otation, **I**solation, & **M**asking in **9** Dimensions

John Tukey

Mary Ann Fisherkeller

Jerome Friedman

PRIM-9, 1972, John Tukey
youtu.be/B7XoW2qiFUA

PRIM-9, 1972, John Tukey
youtu.be/B7XoW2qiFUA

Kinds of Viz Interactions

Select : Mark as interesting

Explore : Show something else

Reconfigure : Show in a new arrangement

Encode : Show a new representation

Abstract/Elaborate : Show more or less detail

Filter : Show conditionally

Connect : Show related items

Techniques for **Selection**

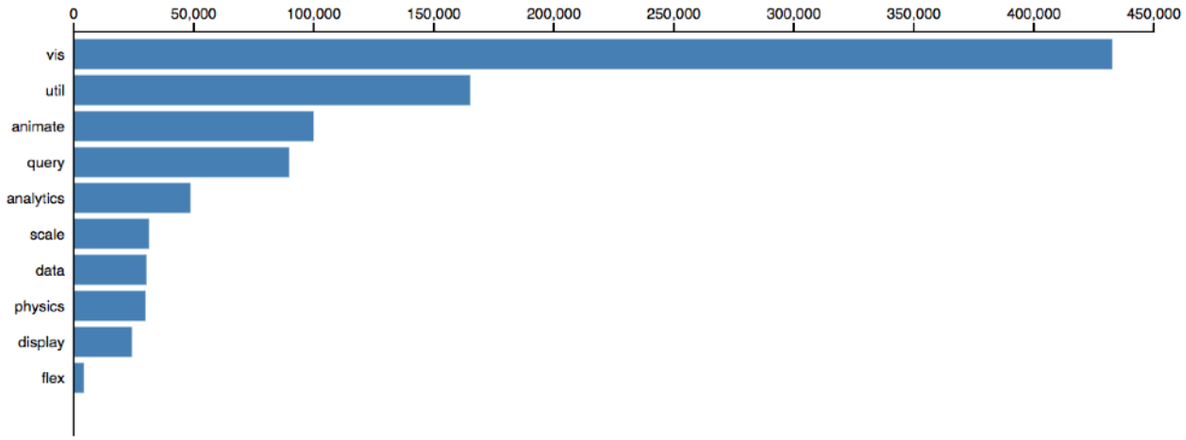
Point / Individual

Hover / Click

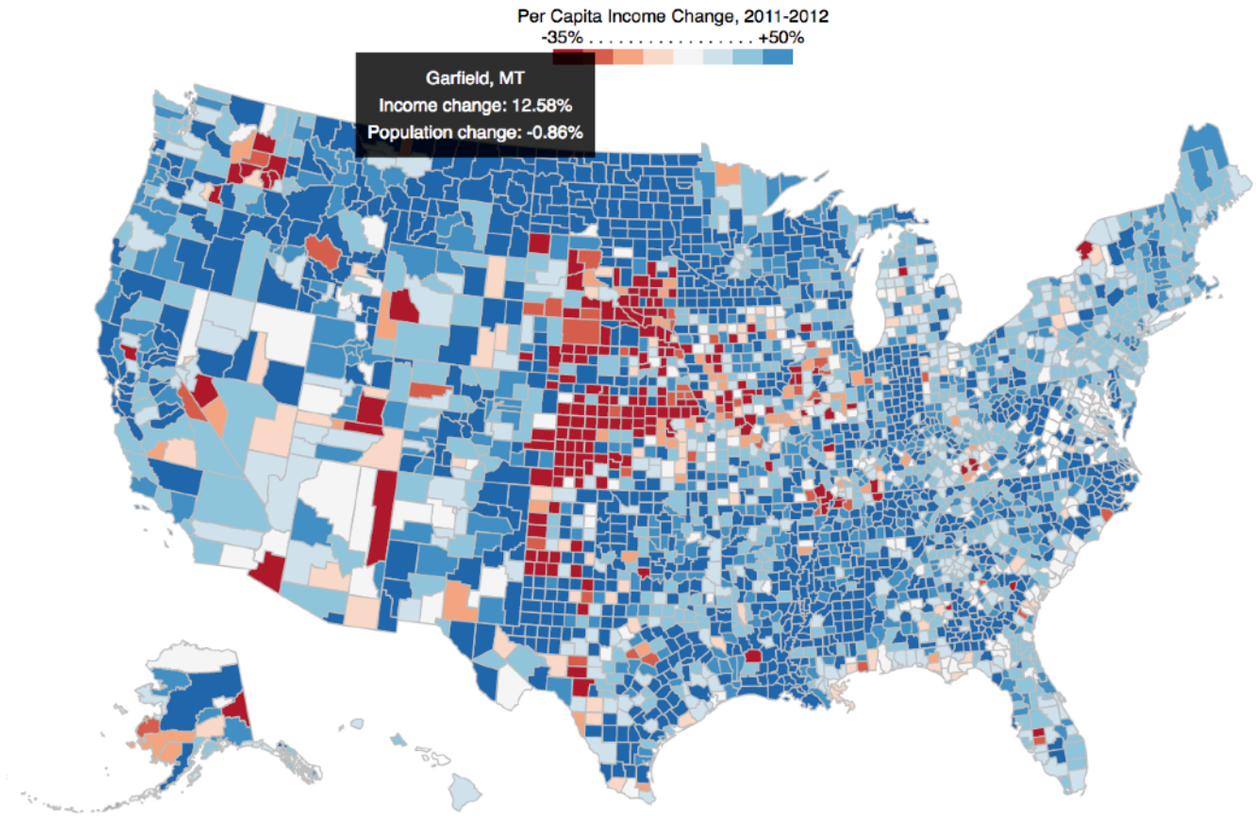
Touch / Tap

Nearest Element

Hover / Click

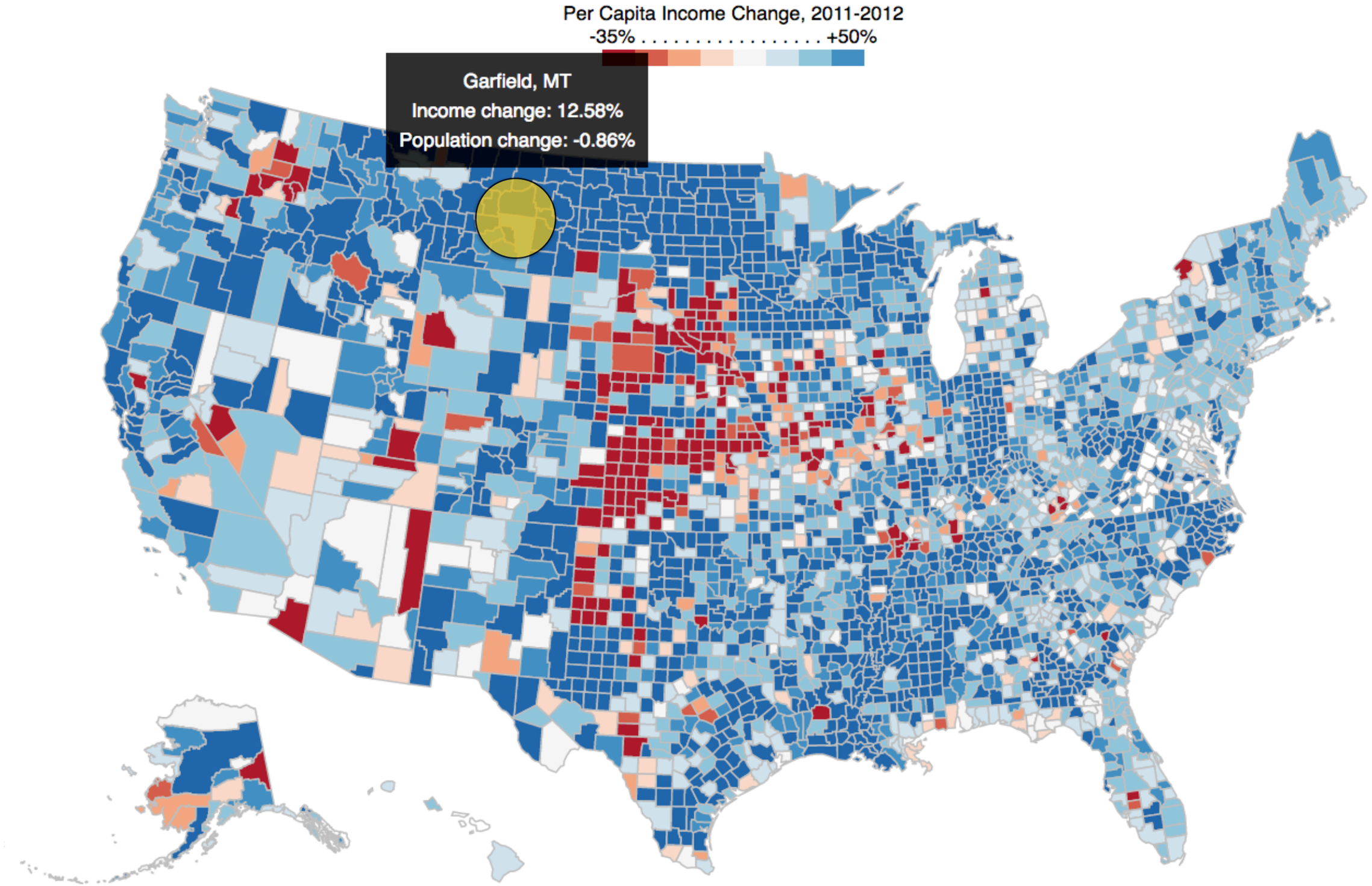


https://bl.ocks.org/mbostock/1283663

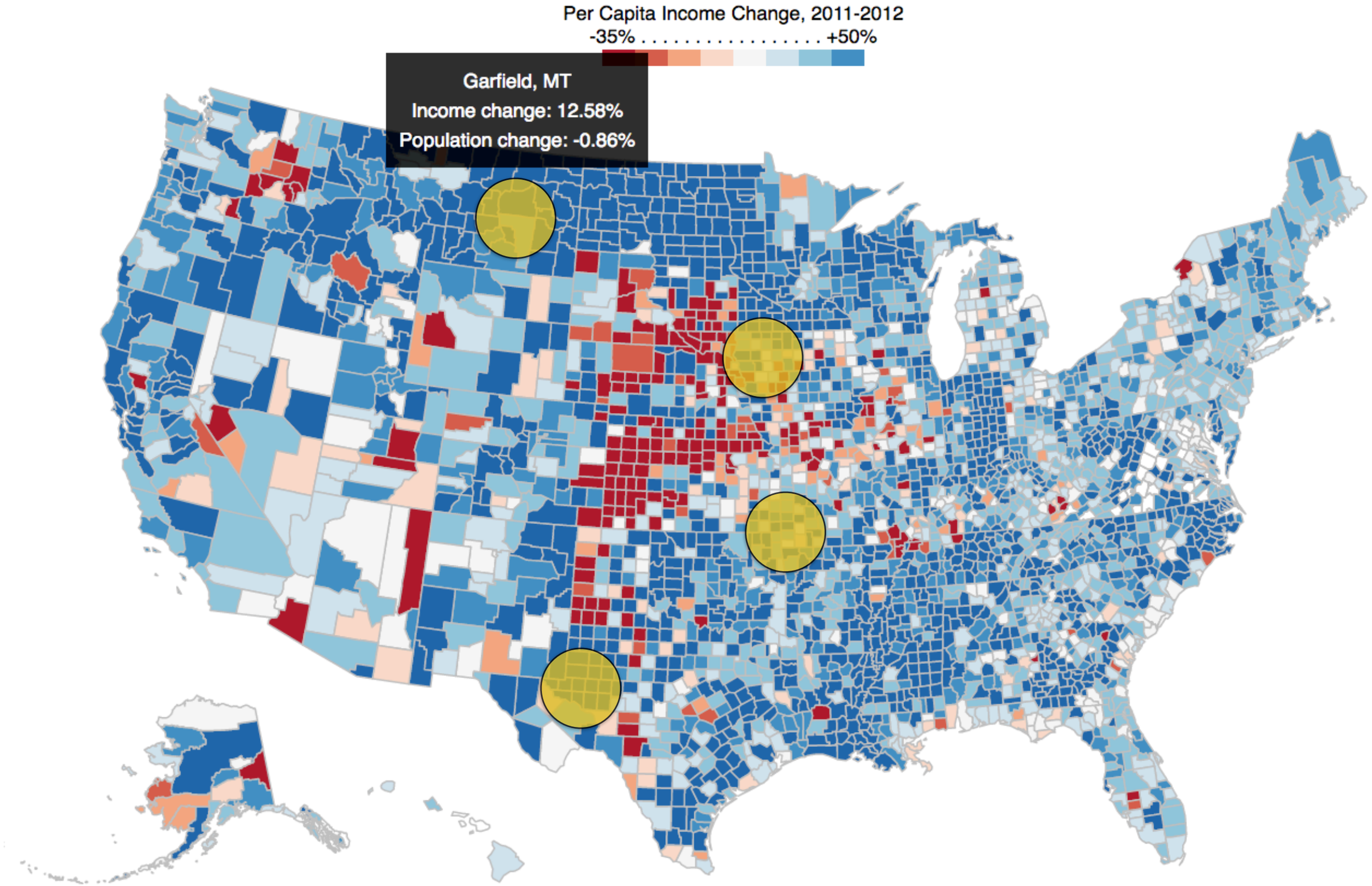


http://bl.ocks.org/stevenae/8362841

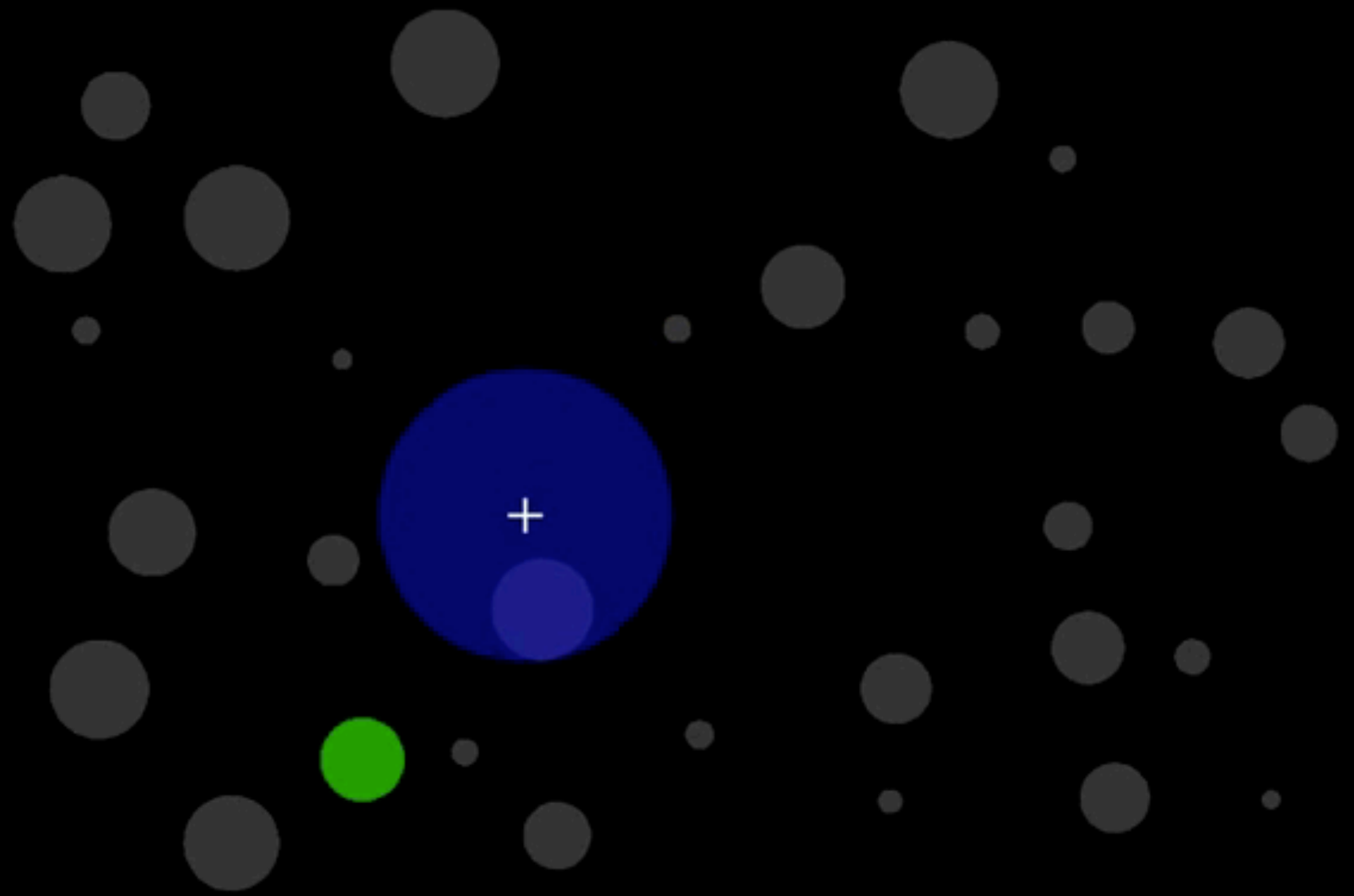
Touch / Tap


Per Capita Income Change, 2011-2012
-35% . . . . . +50%
Garfield, MT
Income change: 12.58%
Population change: -0.86%

Touch / Tap

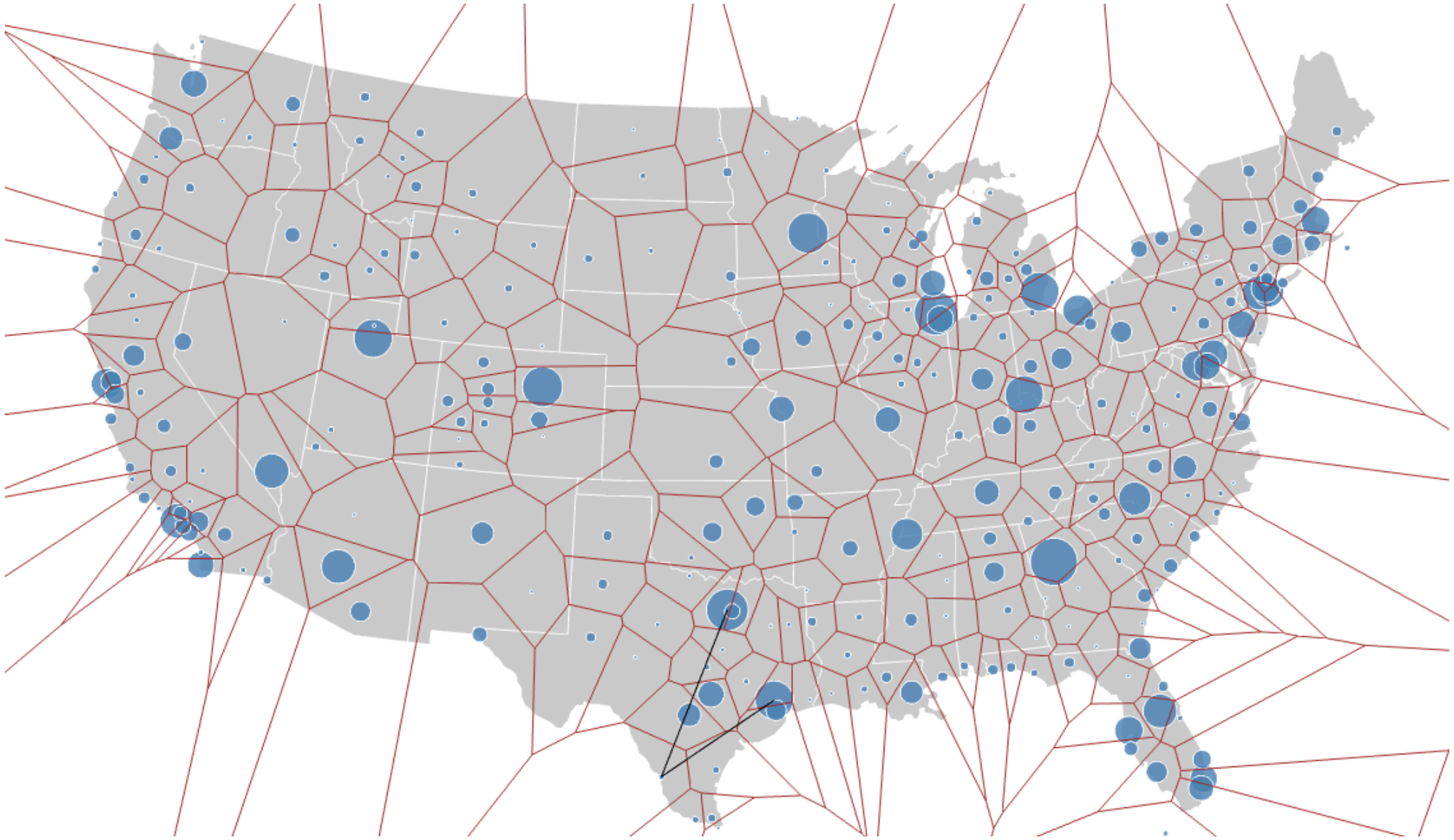

Per Capita Income Change, 2011-2012
-35% . . . . . +50%
Garfield, MT
Income change: 12.58%
Population change: -0.86%

Nearest Element



Bubble Cursor, Grossman & Balakrishnan
youtu.be/JUBXkD_8ZeQ

Nearest Element



http://mbostock.github.io/d3/talk/20111116/airports.html

Techniques for **Selection**

Point / Individual

Hover / Click

Touch / Tap

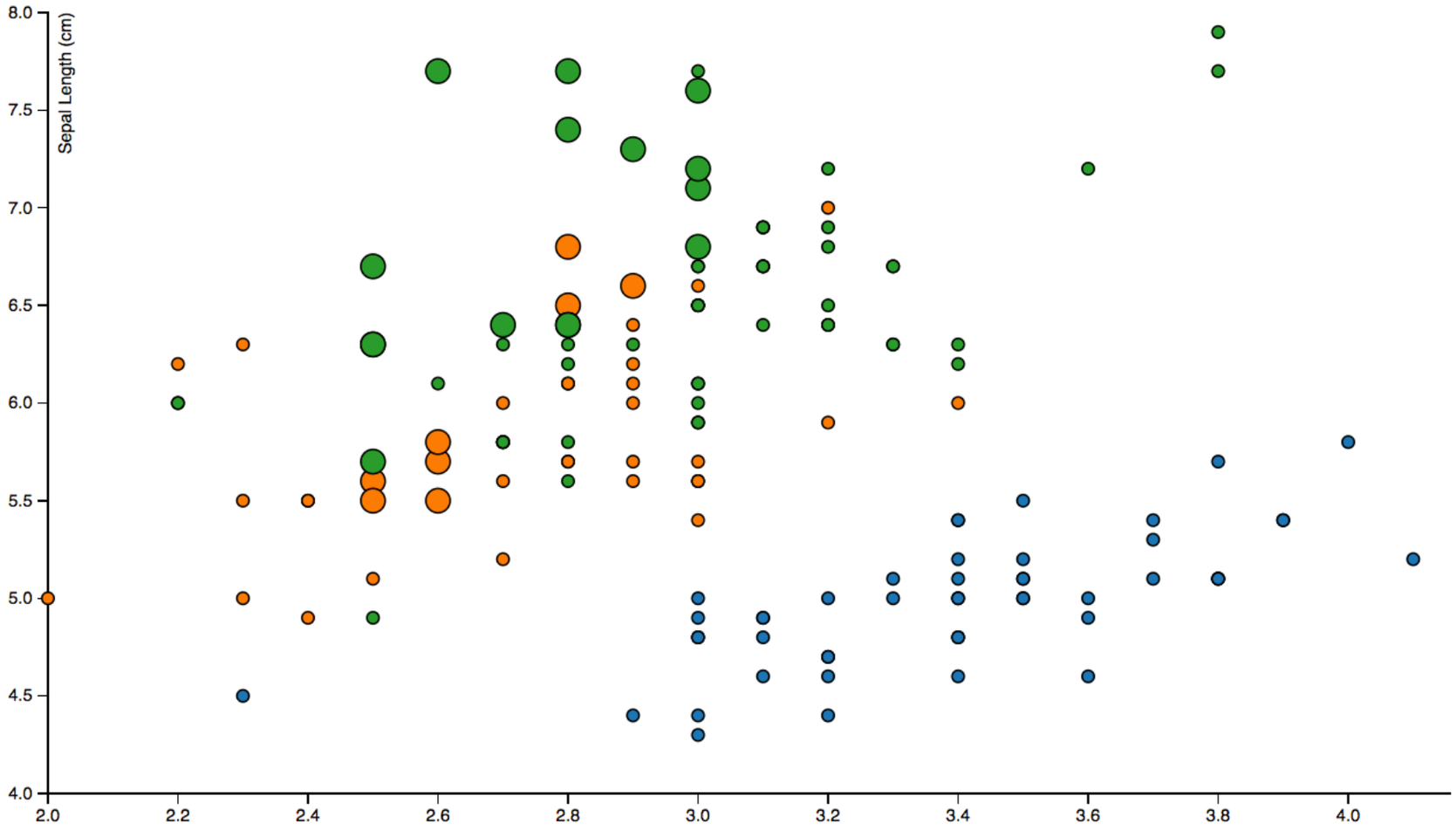
Nearest Element

Region / Group

Rubber-band / Lasso

Area cursor

Rubber-band / Lasso



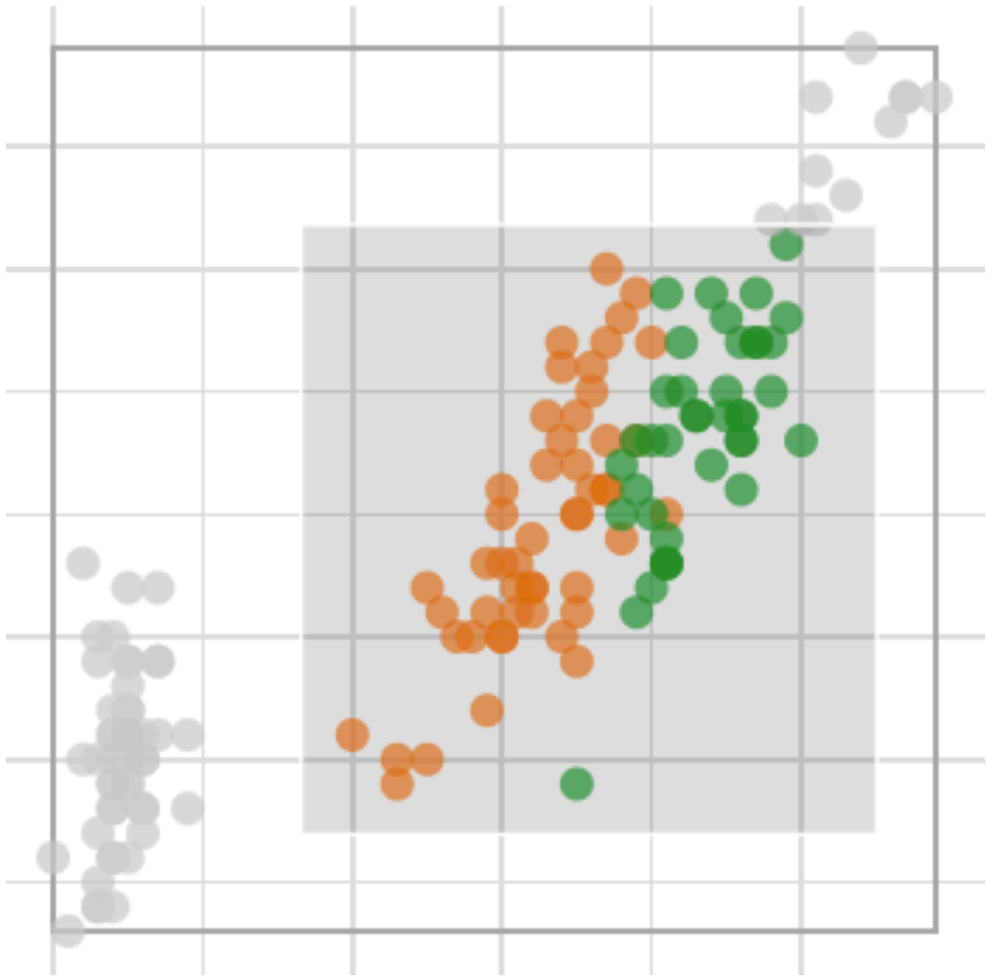
http://bl.ocks.org/skokenes/511c5b658c405ad68941

Brushing & Linking

Select (“brush”) some region of data

See selected data in other views

Components must be **linked**
(i.e. matching points or matching range/values)

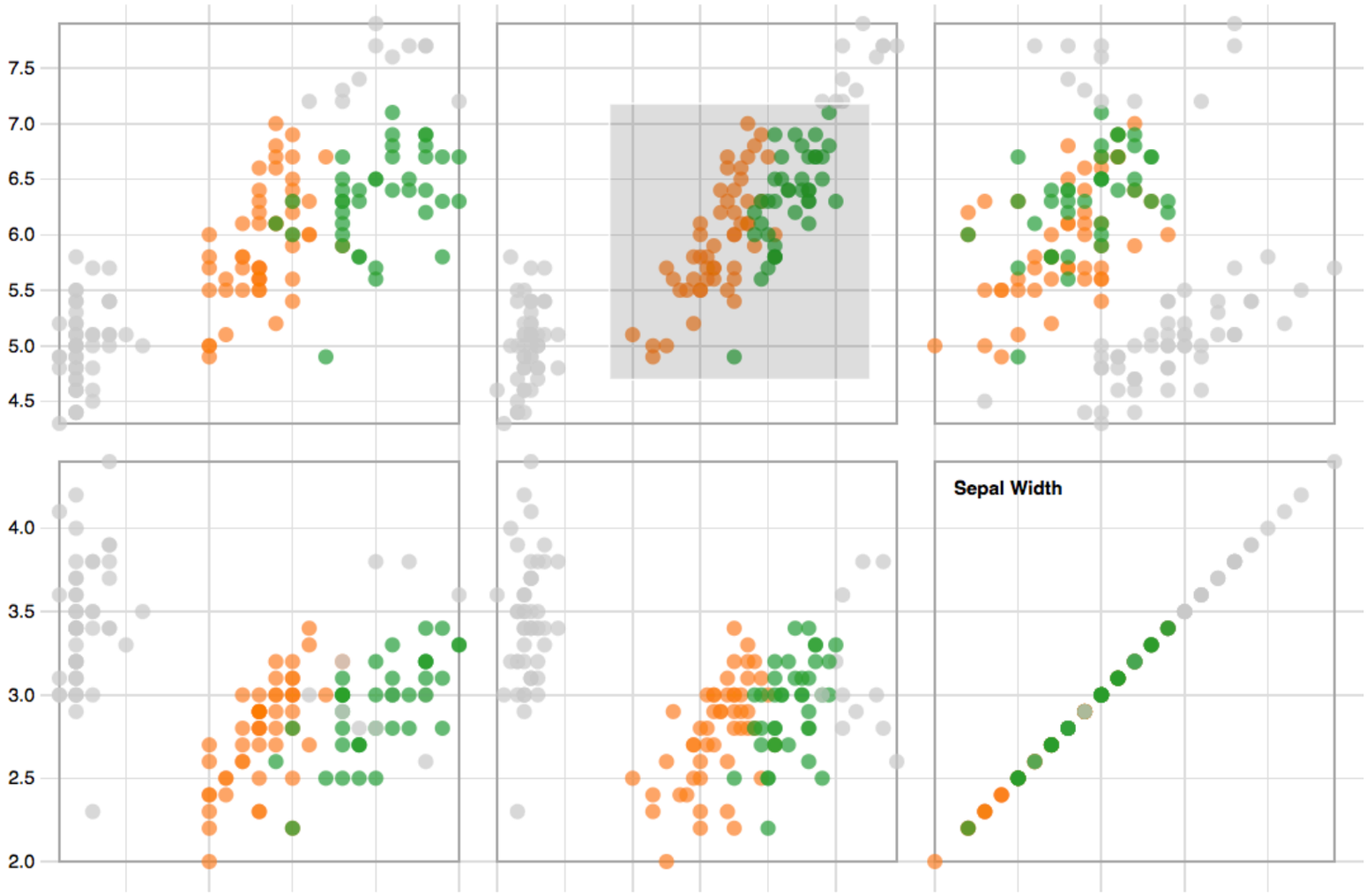


Linked Views

Interactions on one representation change another

Thanks, Jeff Heer

Brushing & Linking

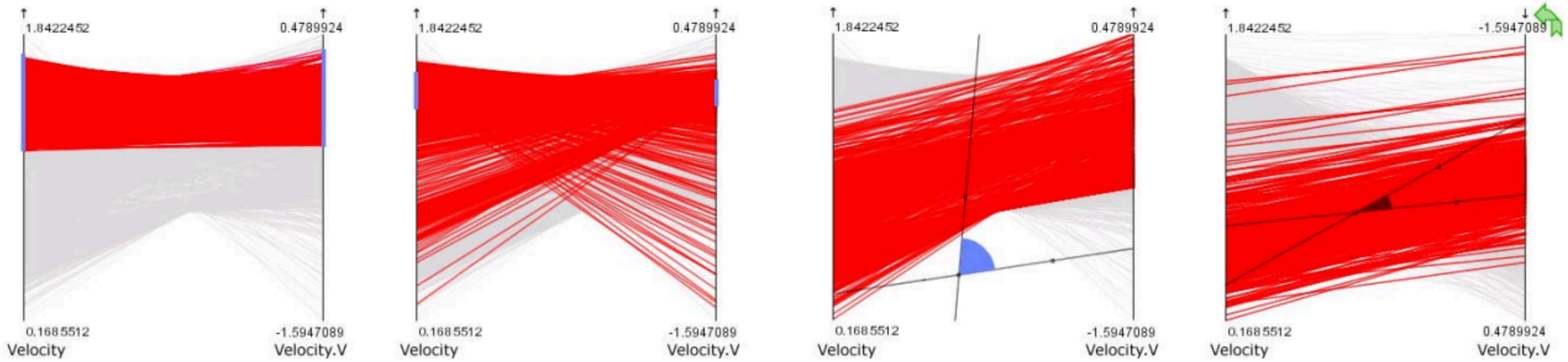


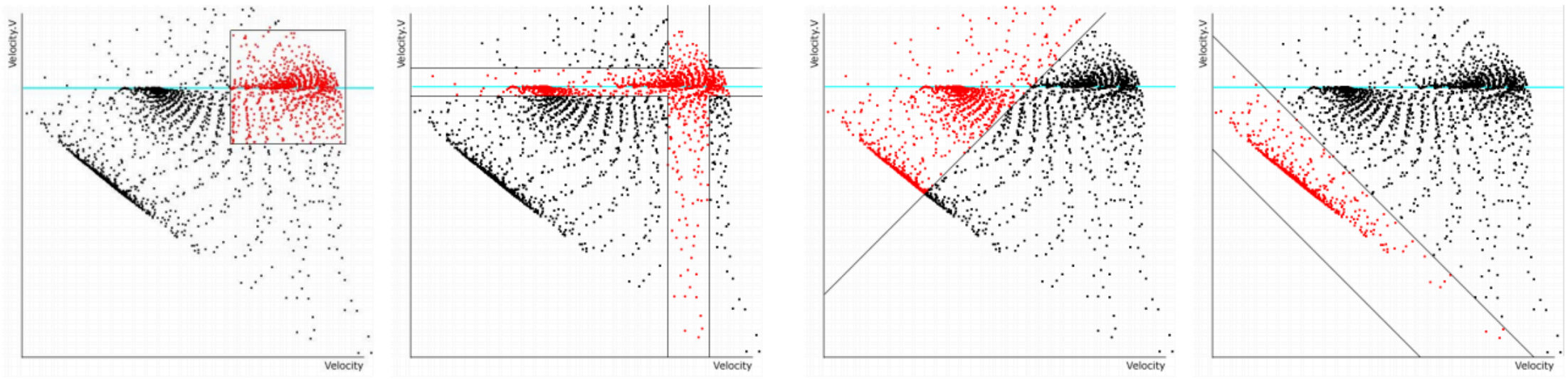
https://bl.ocks.org/mbostock/4063663

Brushing & Linking

composite brushes

angular brushes





AND-brush

OR-brush

angular brush

angular brush,
after axis flipping

Hauser, H., Ledermann, F. and Doleisch, H., 2002. Angular brushing of extended parallel coordinates. In *Information Visualization*

Dynamic Queries

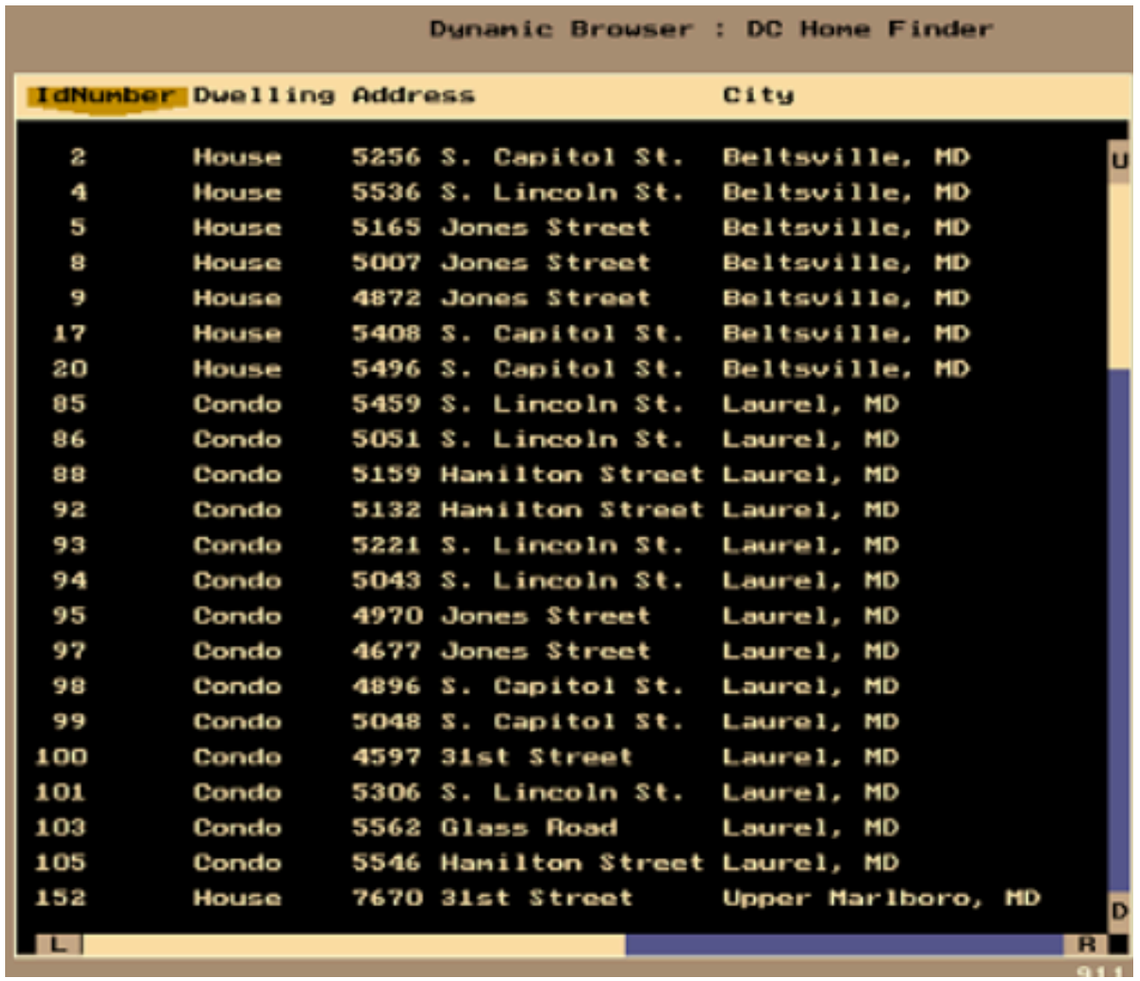
Traditional **SQL Query**

"Request for information from a data store"

SELECT house **FROM** dc_homes

WHERE price < 600,000 **AND** bedrooms > 1

ORDER BY price



What's wrong with written queries?

Programmatic

Exact matches instantly displayed

Often too few or too many results

No hinting, guidance

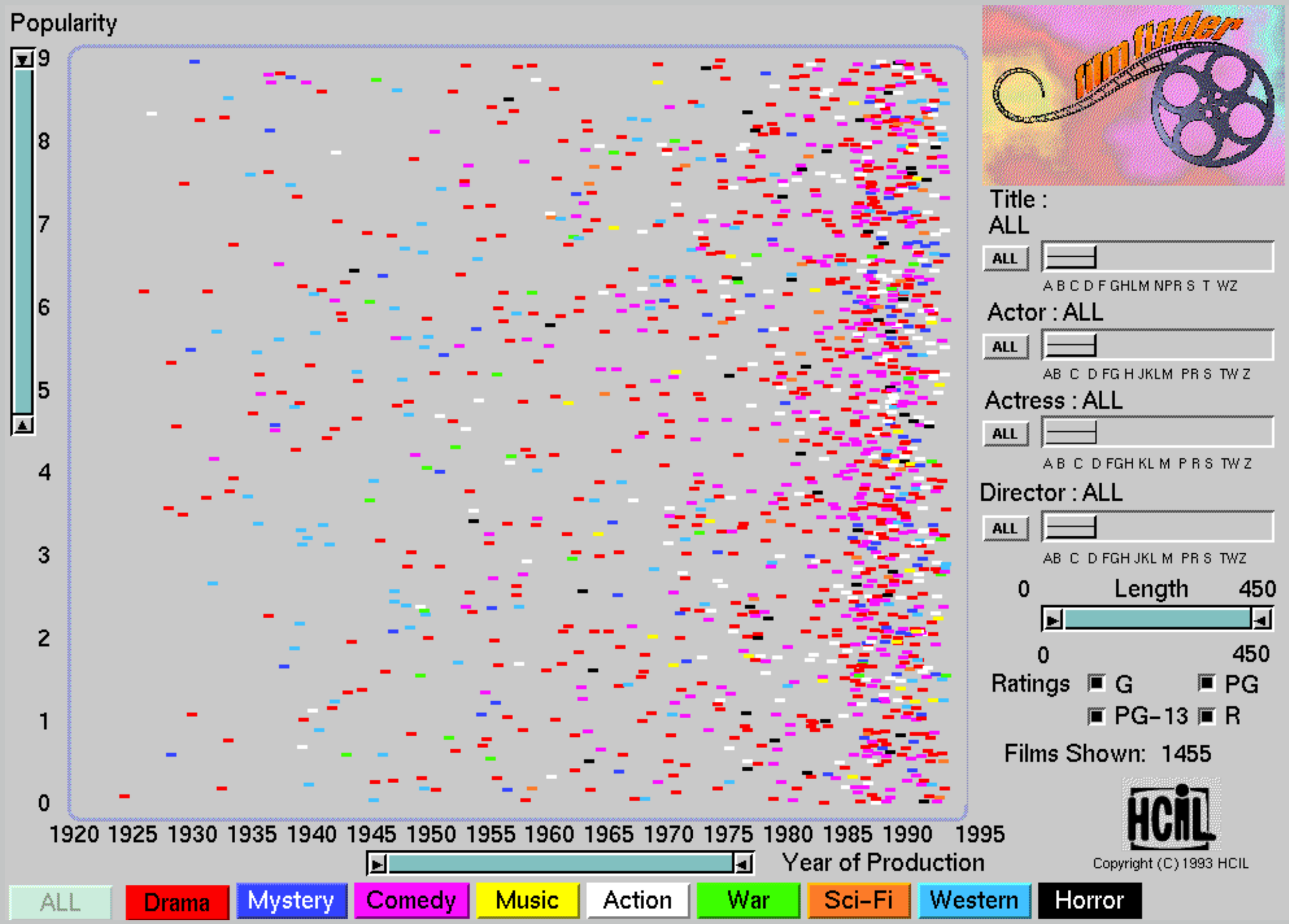
Slow sensemaking loop

Tabular or textual results (often)

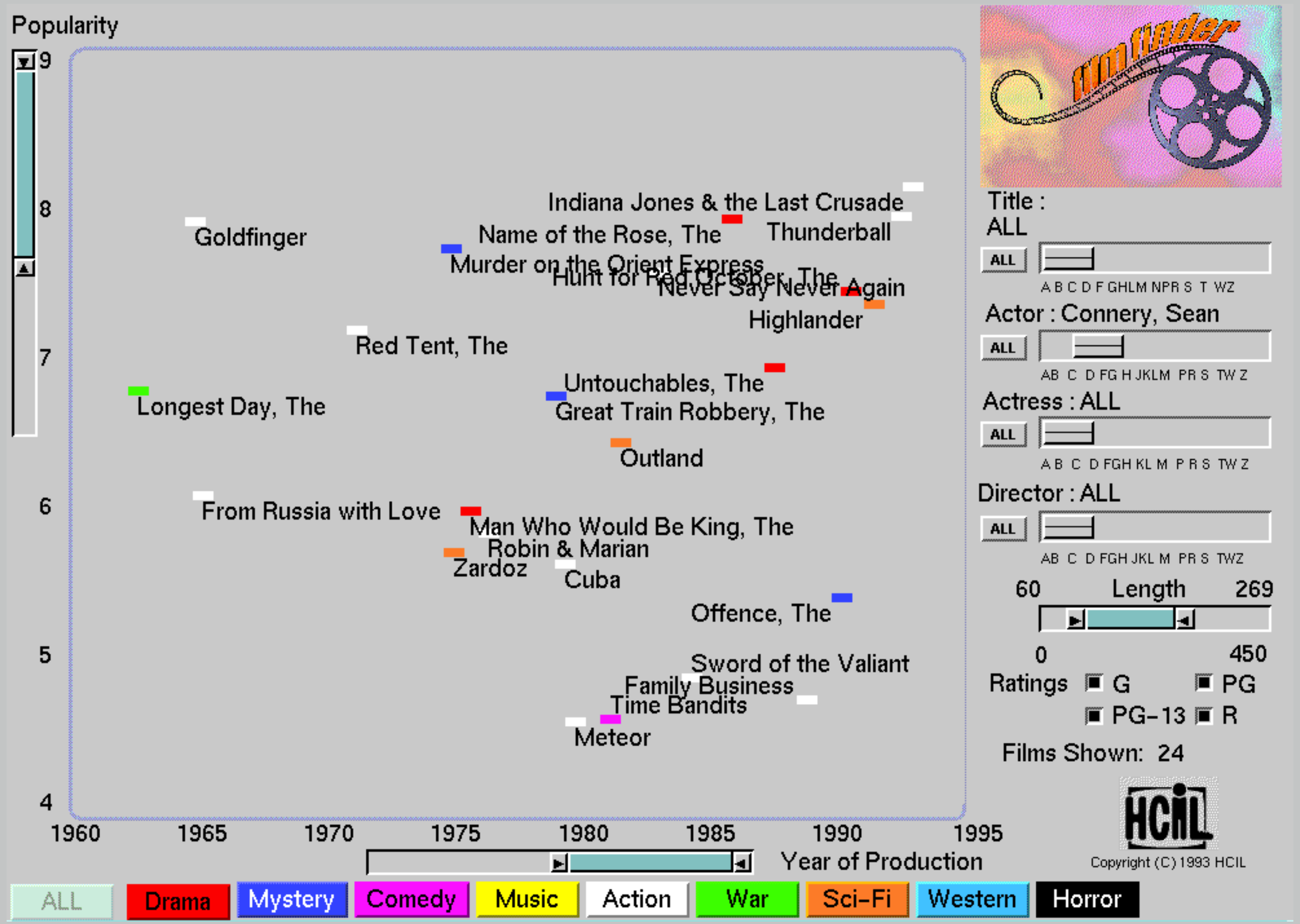
Dynamic Homefinder, 1992, Williamson & Shneiderman
youtu.be/5X8XY9430fM

Direct Manipulation

1. **Represent** all objects and actions visually
2. Afford **rapid**, **incremental**, and **reversible** actions
3. Select/filter by **pointing**
4. **Immediately** and **continuously** display results



Ahlberg, C. and Shneiderman, B., 1994, April. Visual information seeking using the filmfinder.



Ahlberg, C. and Shneiderman, B., 1994, April. Visual information seeking using the filmfinder.

Popularity

9
8
7
6
5
4

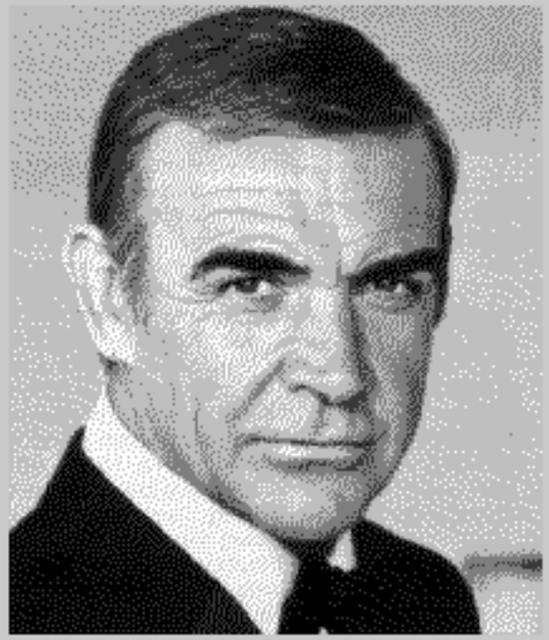
Goldfinger
Indiana Jones & the Last Crusade
Name of the Rose, The
Thunderball
Murder on the Orient Express
Hunt for Red October, The
Never Say Never Again
Highlander
Red Tent, The
Untouchables, The
Longest Day, The
Great Train Robbery, The

Murder on the Orient Expre

Director: Lumet, Sidney Year: 1974
Country: USA Language: English
Actors: Actresses:

Balsam, Martin
Cassel, Jean-Pierre
Perkins, Anthony
Connery, Sean
Gielgud, John

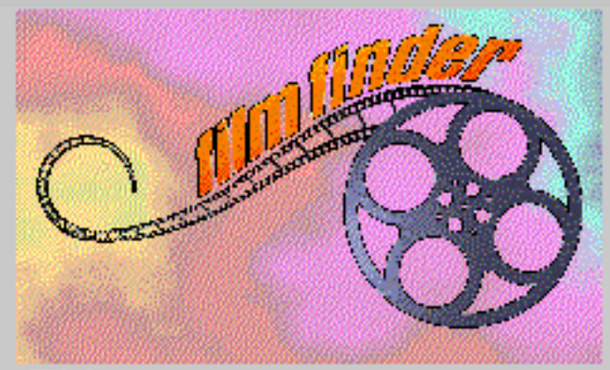
Bacall, Lauren
Bergman, Ingrid
Bisset, Jacquelin
Hiller, Wendy



liant

1960 1965 1970 1975 1980 1985 1990 1995

Year of Production



Title :
ALL
ALL
A B C D F G H L M N P R S T W Z

Actor : Connery, Sean
ALL
A B C D F G H J K L M P R S T W Z

Actress : ALL
ALL
A B C D F G H K L M P R S T W Z

Director : ALL
ALL
A B C D F G H J K L M P R S T W Z

60 Length 269
0 450

Ratings G PG PG-13 R

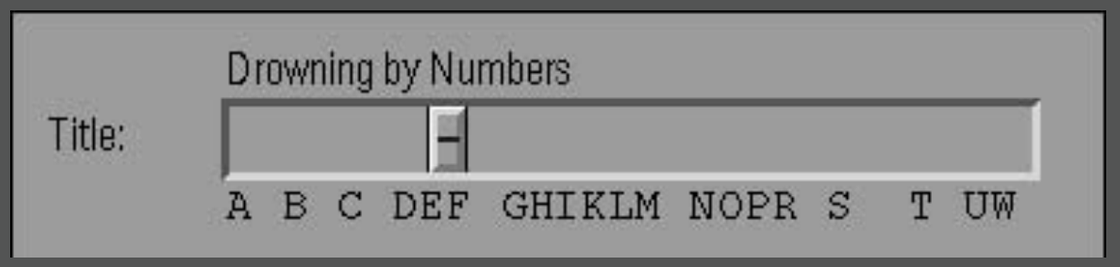
Films Shown: 24

HCIL

ALL | Drama | Mystery | Comedy | Music | Action | War | Sci-Fi | Western | Horror

Ahlberg, C. and Shneiderman, B., 1994, April. Visual information seeking using the filmfinder.

Alphaslider

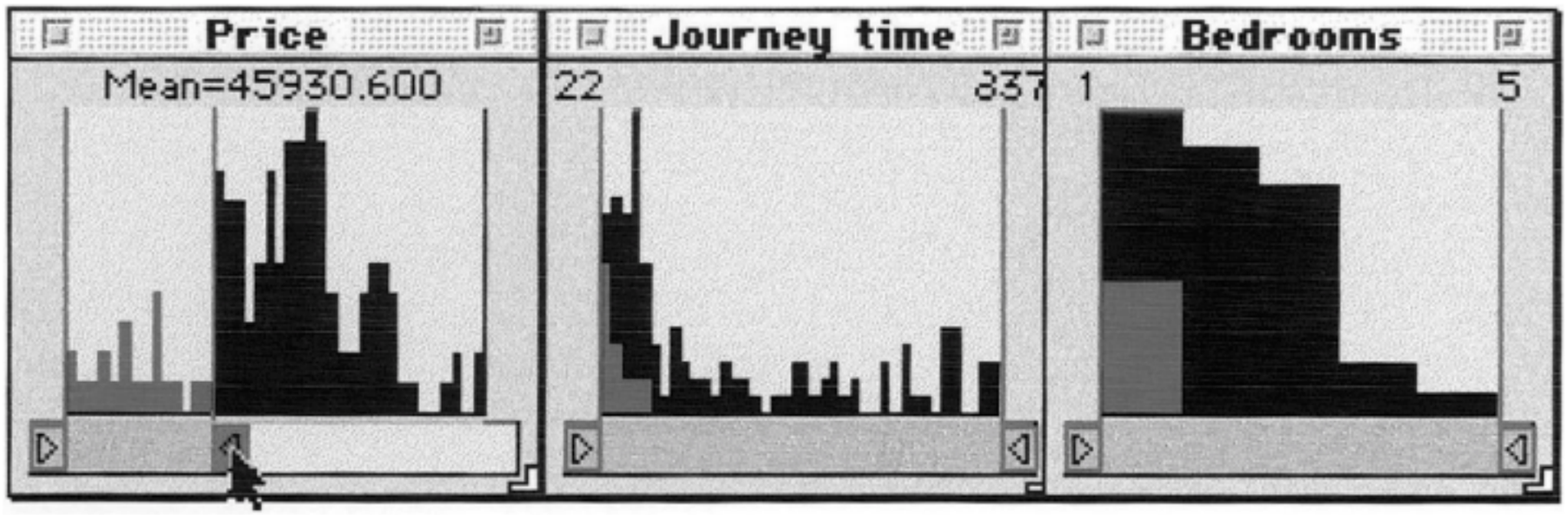


Rangeslider

Toggles

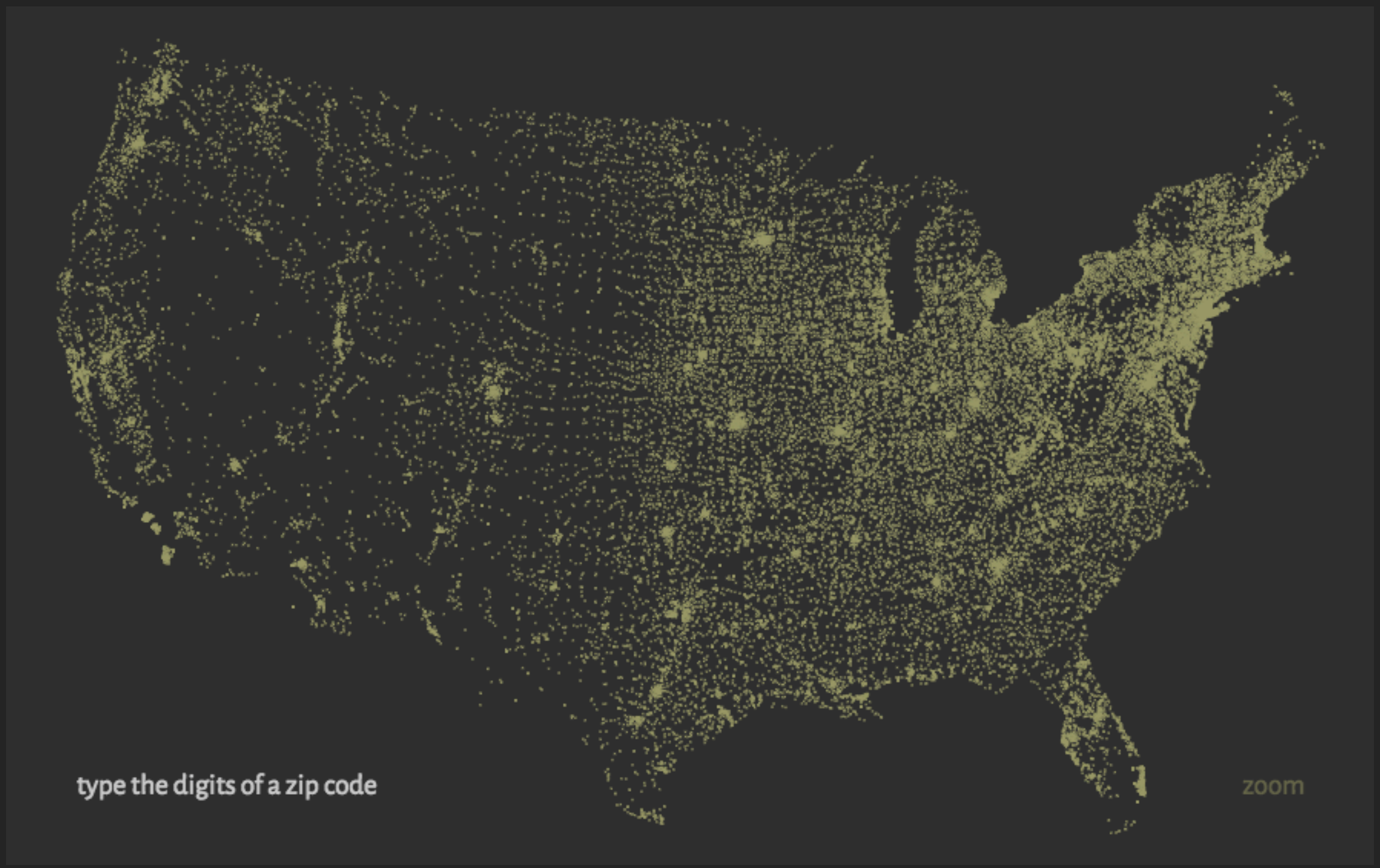
Ahlberg, C. and Shneiderman, B., 1994, April. Visual information seeking using the filmfinder.

Attribute Explorer



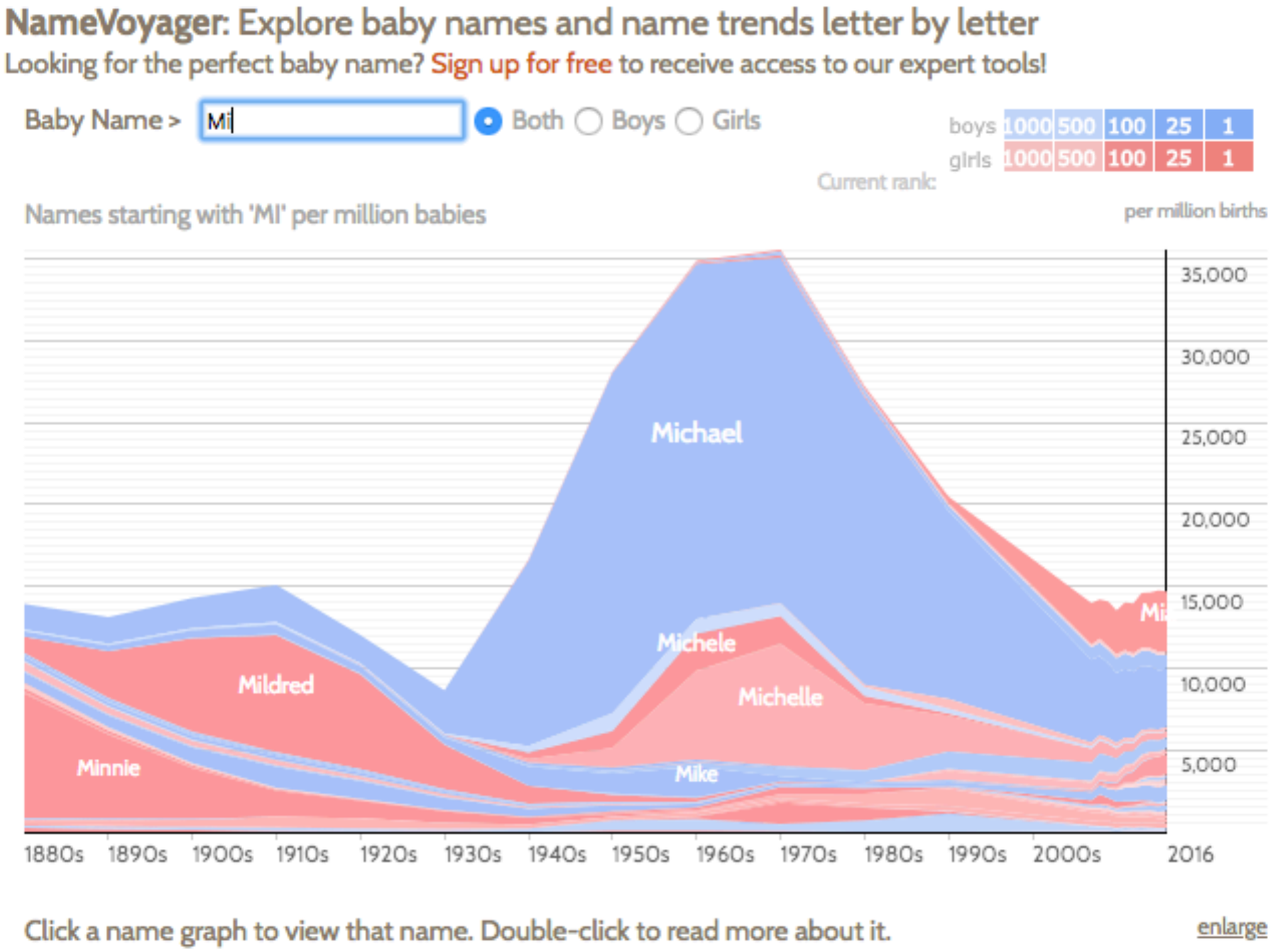
Expand vocabulary for direct manipulation

Spence, R. and Tweedie, L., 1998. The Attribute Explorer: information synthesis via exploration.

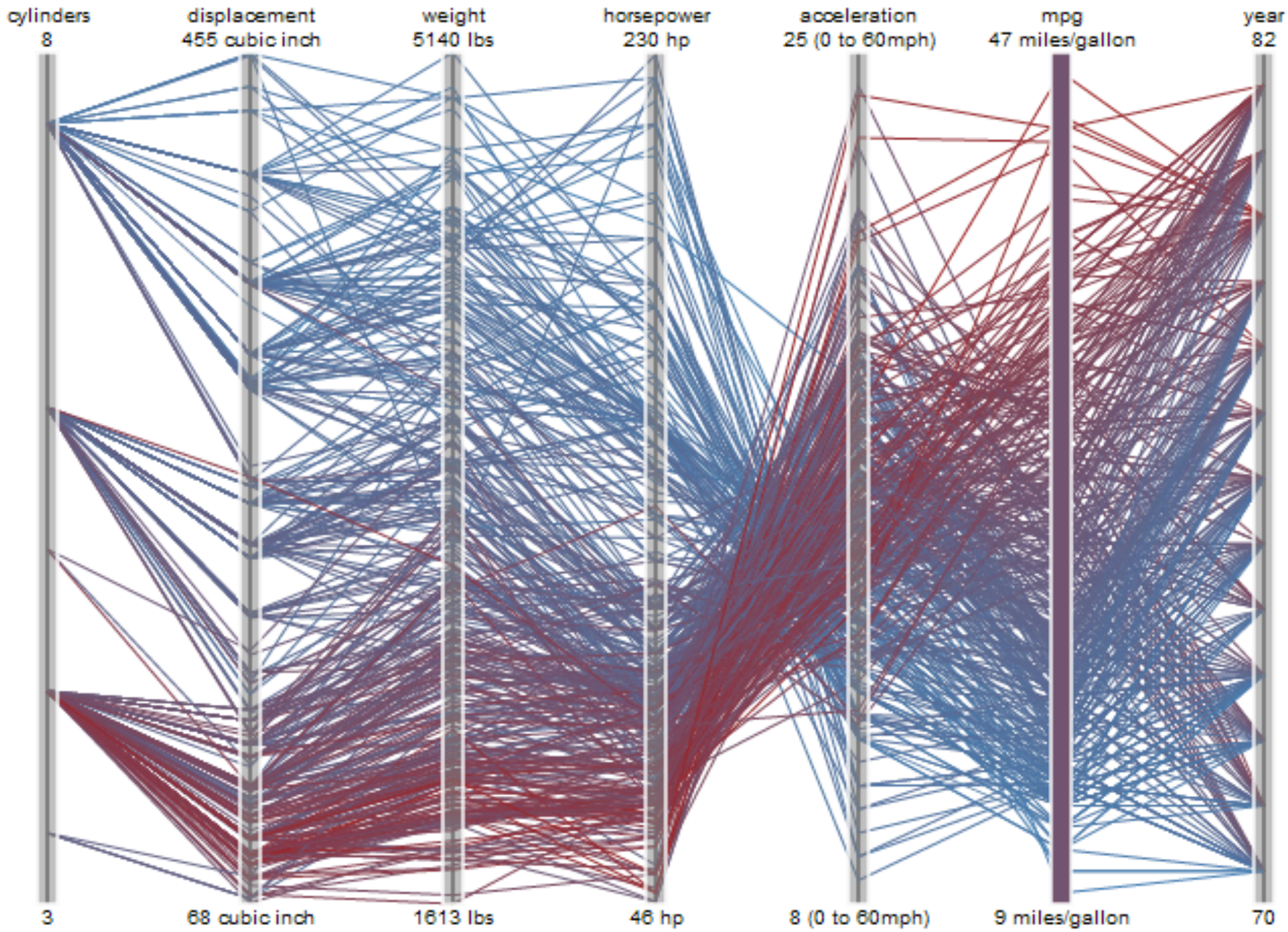


http://benfry.com/zipdecode/

http://www.babynamewizard.com/voyager



https://jsfiddle.net/eamonnmag/o4tvekLg/



Choosing Interactions

- People “interact” with static viz — eye gaze, pointing
- Match interactions with visual metaphor
- Match interactions with target insights
- Take advantage of human strengths,
  consider potential weaknesses
- Augment, don’t just afford because you can

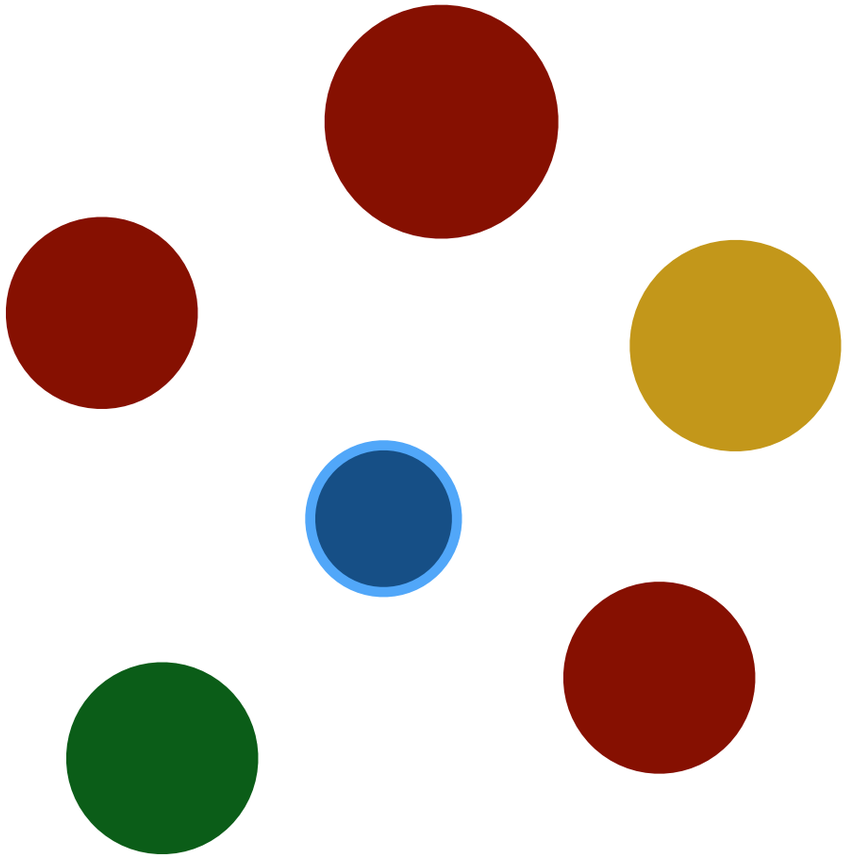
Bonus slides

Widgets -> Query -> Onscreen Selection

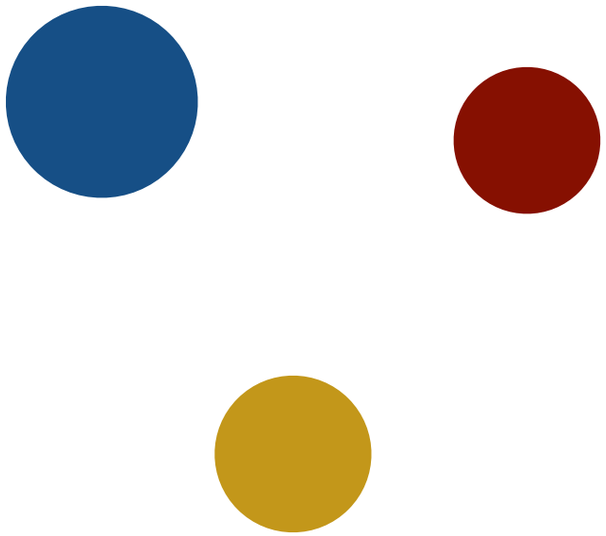
Widgets -> Query -> Onscreen Selection

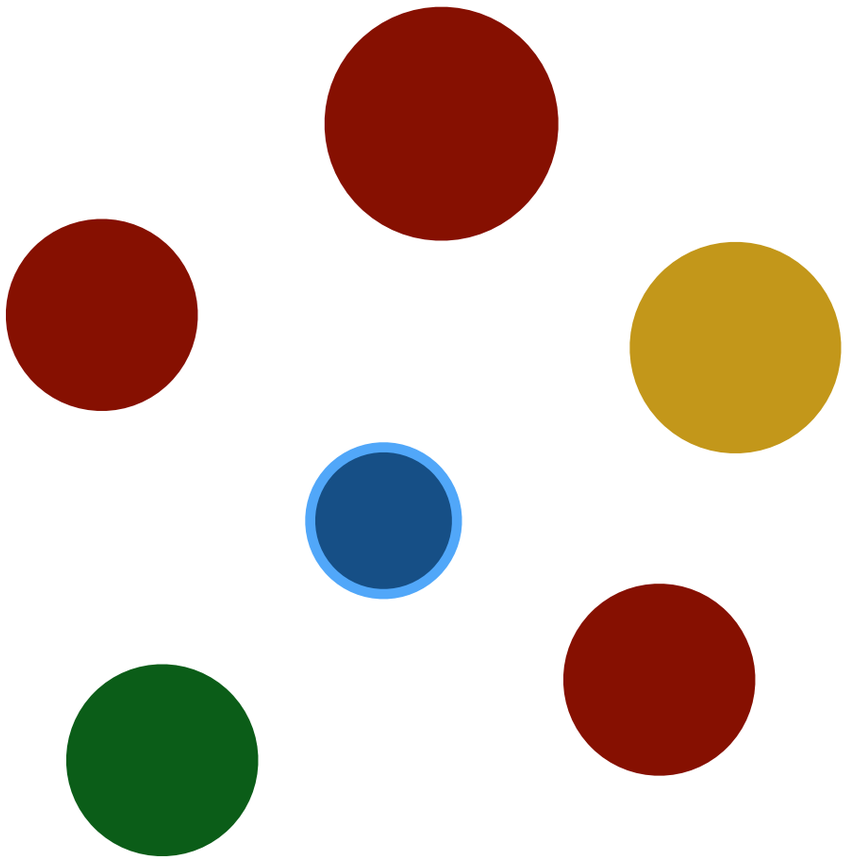
Onscreen Selection -> Query -> (Encoding)

Query by Example



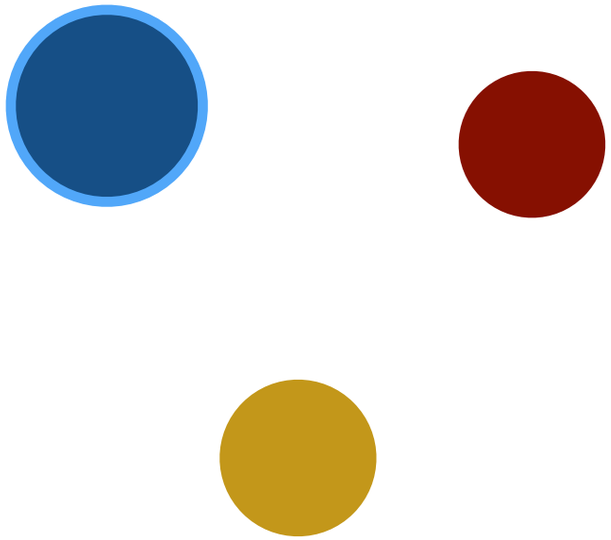
Point to example and define an **abstraction** from its properties

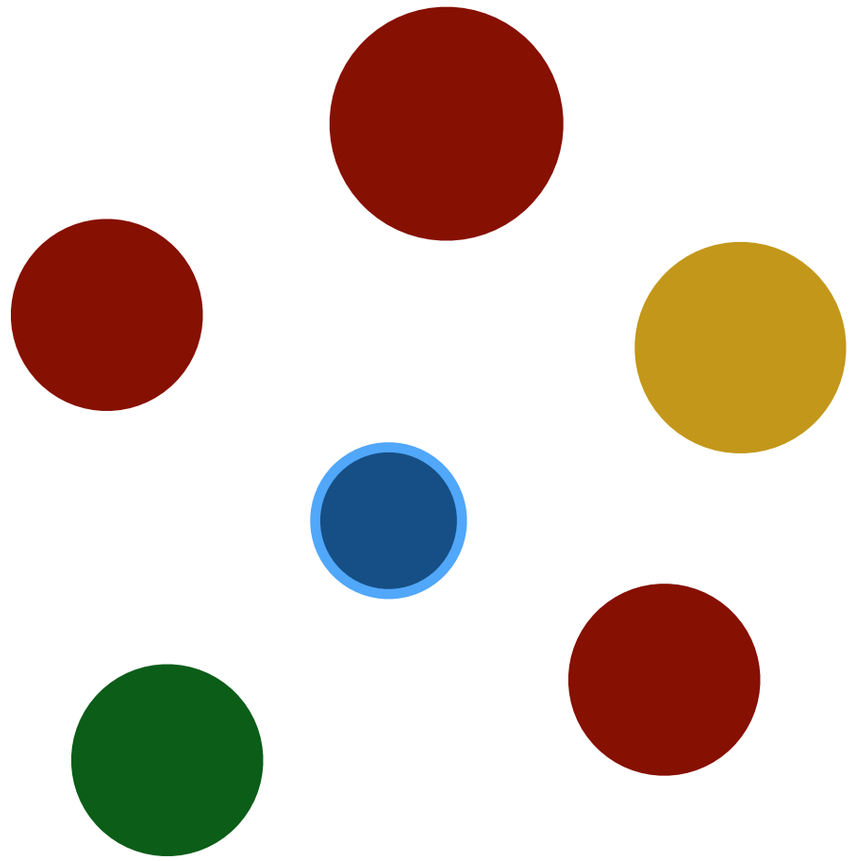




Point to example and define an **abstraction** from its properties

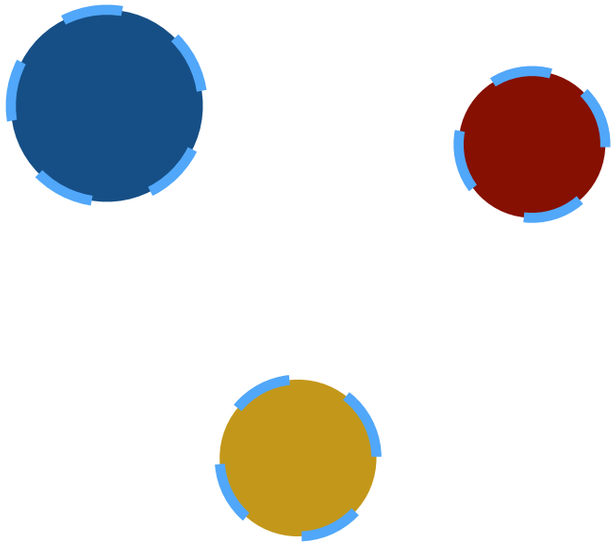
“blue like this circle”

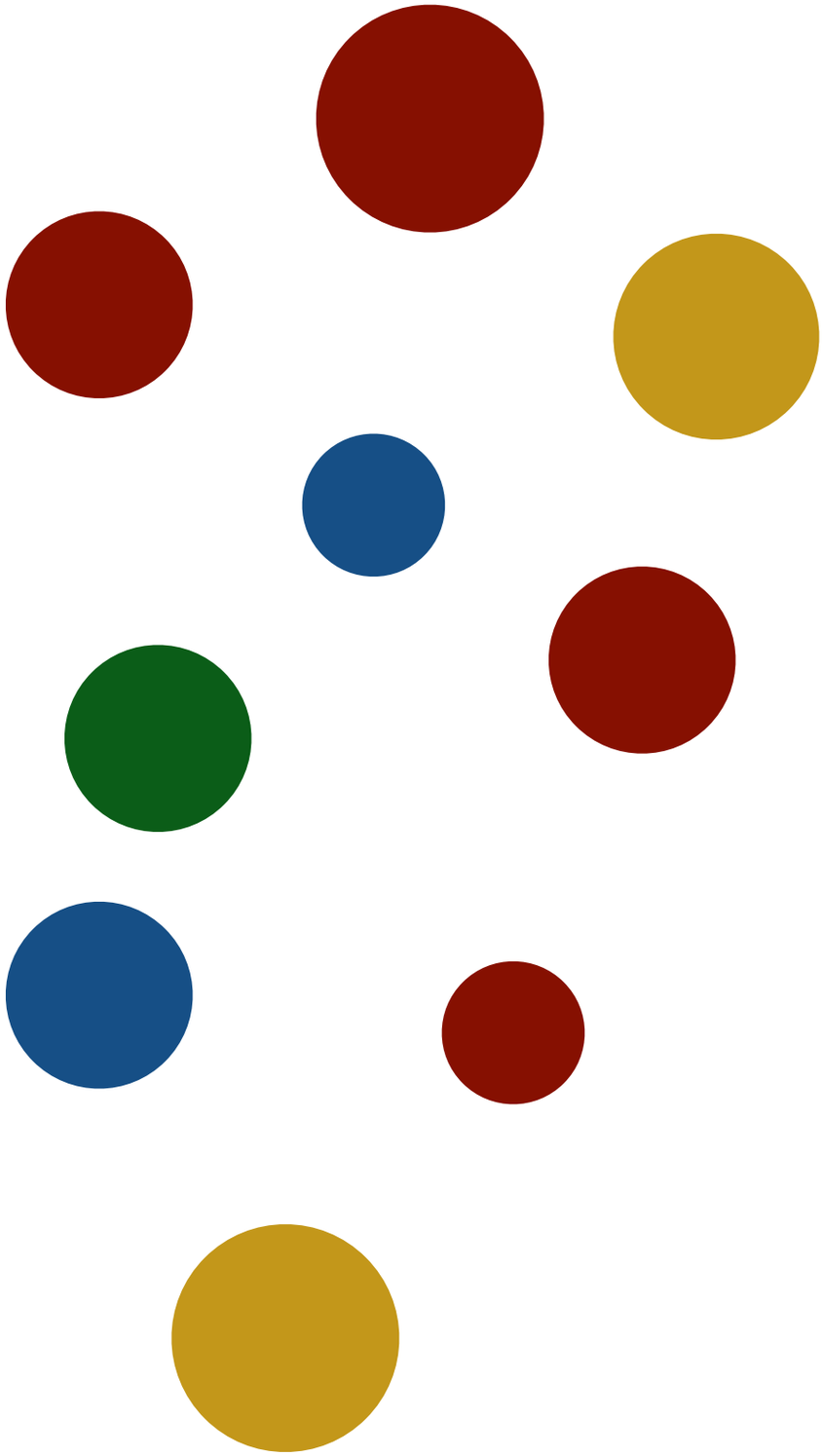




Point to example and define an **abstraction** from its properties

“same size AND same color”





Point to example and define an **abstraction** from its properties

- Single- or multi-dimensional
- AND / OR composition
- Works for many kinds of data
- Dissimilarity metrics