Visualization in HCI

05-499/05-899 Section C

Carnegie Mellon University Human-Computer Interaction Institute

Interaction

March 1, 2017

Announcement

Next Wednesday is International Women's Day and "A Day Without a Woman”

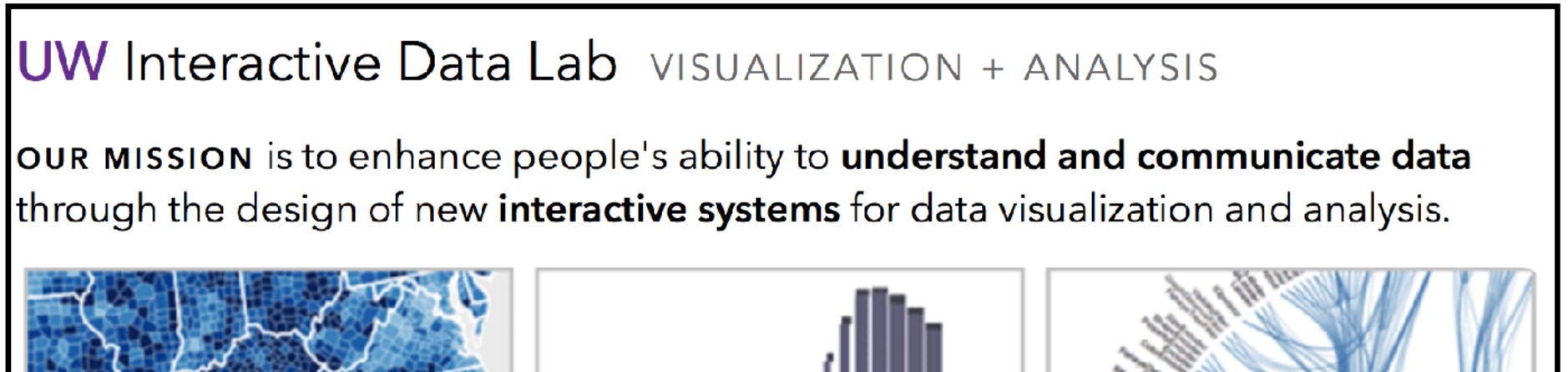
- No class on March 8 so those who wish can participate.

Instead, I encourage you to attend this upcoming seminar **on Friday**:

- Prof. Jeffrey Heer - Predictive Interaction

  Friday, March 3, 2017, 1:30pm to 2:30pm

  Newell-Simon Hall 1305 (Michael Mauldin Auditorium)



Announcement

On Monday, we will have a guest lecture by Nikola Banovic on the Data Science Pipeline and how to ask “good questions” from data.

Project

It’s time to start thinking about your project.

Your project proposal will be due Wednesday, March 22

What you need:

- A team (2-3 people)
- An idea
- A dataset (that you actually can get!)

More Info: https://cmu-vis-course.github.io/2017/project/

Project Requirements

We will mutually agree on the scope.

Be ambitious! In your proposal, define your goals and categorize them:

- must have, nice to have, etc.
- check out examples of excellent student projects from other courses!

Minimum:

- original idea of dataset/vis combo
- interactive
- at least two coordinated views

Interaction

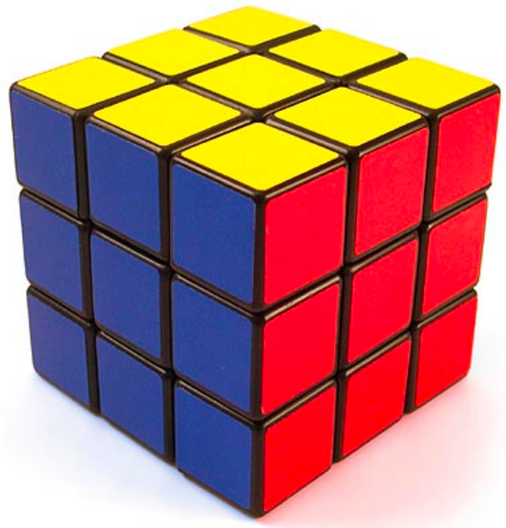
Why Interact with Visualization?

Explore data that is big / complex

- to big to show everything at once
- explore data with different representations

Interaction amplifies cognition

- We understand things better if we can touch them
- If we can observe cause and effect



Interaction Methods

What do you design for?

- Mouse, keyboard?
- Touch interaction / mobile?
- Gestures?
- Eye Movement?

https://www.youtube.com/watch?v=QXLfT9sFcbc

Types of Interaction

Single View

Change over time

Navigation

Semantic zooming

Filtering and Querying

Focus + Context

Multiple Views

Selection (Details on Demand)

Linking & Brushing

Adapting Representations

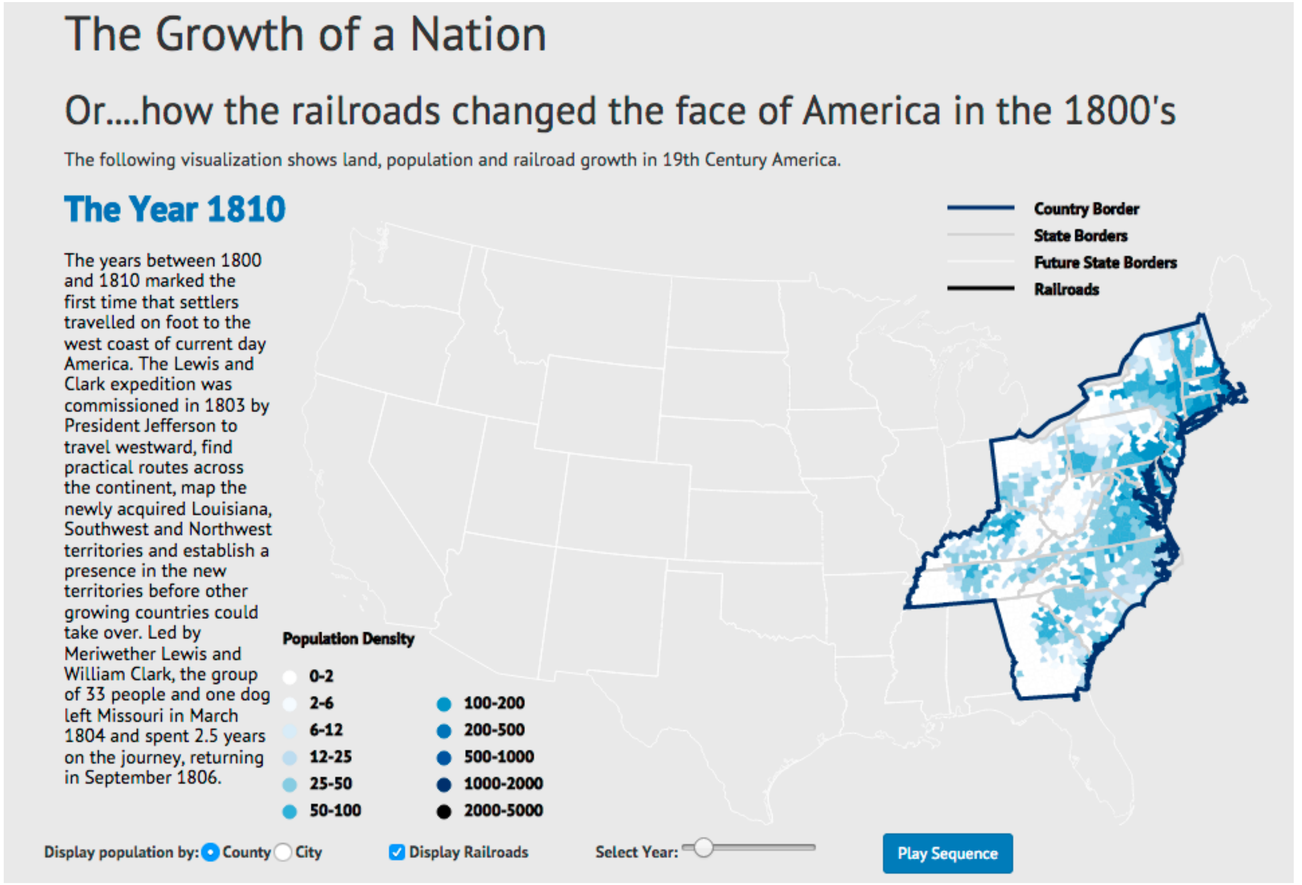
Future Lecture

Change over Time / Transitions

Change over Time

E.g. use a slider to see view with data at different times

Sometimes better to show difference explicitly

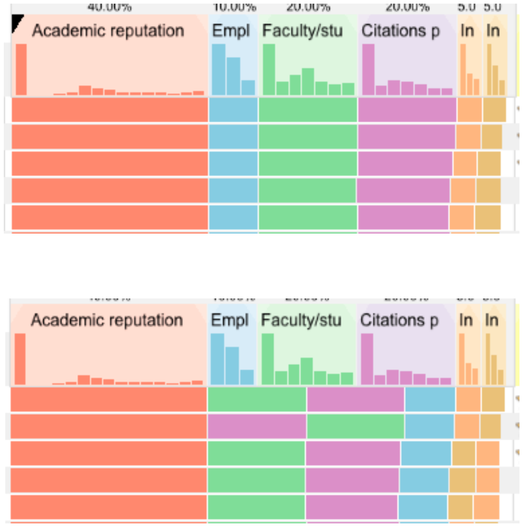


[Lauren Wood]

Change over Time

Doesn’t have to be literal time:

- change as you go
- as part of an analysis process



https://www.youtube.com/watch?v=iFqCBI4T8ks&feature=youtu.be

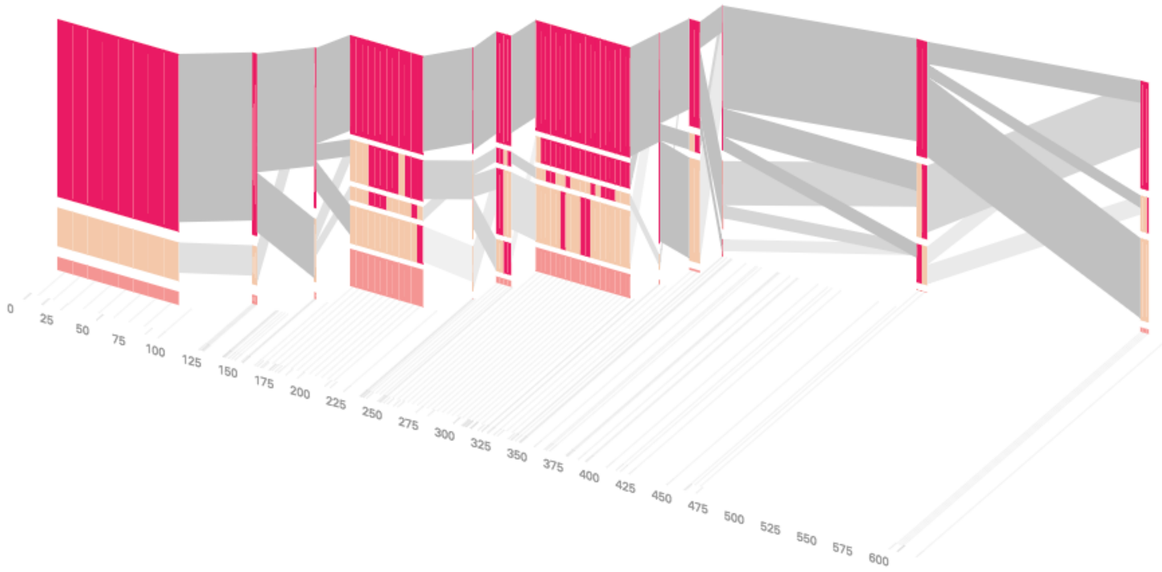
Why Transition?

Different representations support different tasks

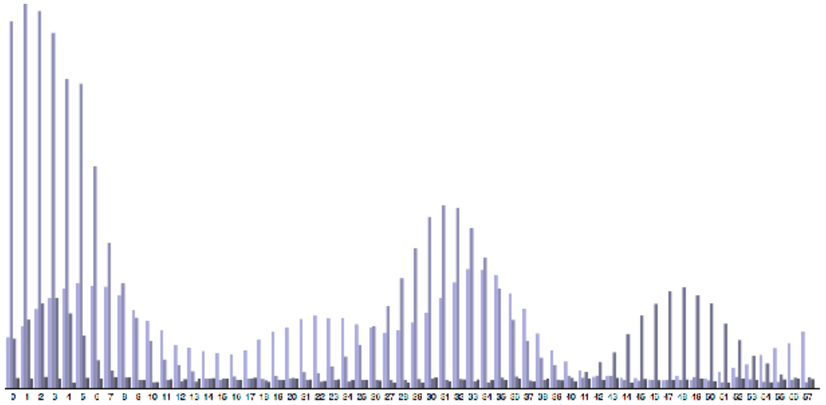
- bar chart, vs stacked bar chart

Change Ordering

Transition make it possible for users to track what is going on



Animated Transitions



Smooth interpolation between states or visualization techniques

[Sunburst by John Stasko, Implementation in Caleydo by Christian Partl]

Why Animated Transition?

Animated Transitions in Statistical Data Graphics

Jeffrey Heer, George G. Robertson

Abstract—In this paper we investigate the effectiveness of animated transitions between common statistical data graphics such as bar charts, pie charts, and scatter plots. We extend theoretical models of data graphics to include such transitions, introducing a taxonomy of transition types. We then propose design principles for creating effective transitions and illustrate the application of these principles in *DynaVis*, a visualization system featuring animated data graphics. Two controlled experiments were conducted to assess the efficacy of various transition types, finding that animated transitions can significantly improve graphical perception.

Index Terms—Statistical data graphics, animation, transitions, information visualization, design, experiment

1 Introduction

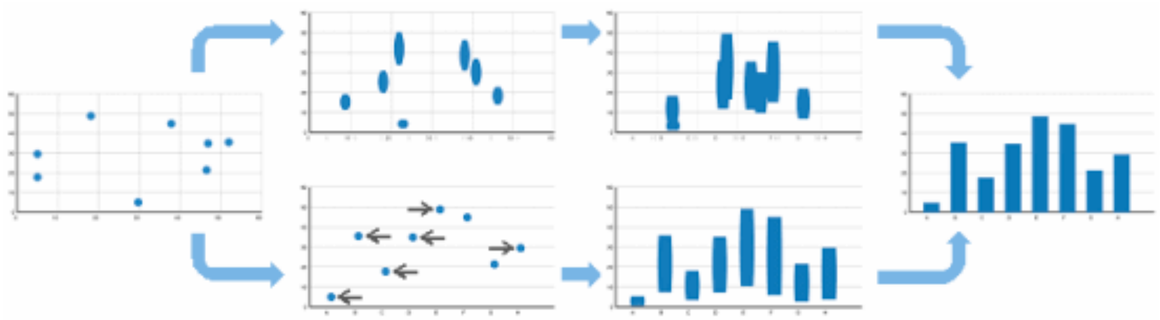
In both analysis and presentation, it is common to view a number of related data graphics backed by a shared data set. For example, a business analyst viewing a bar chart of product sales may want to view relative percentages by switching to a pie chart or compare sales with profits in a scatter plot. Similarly, she may wish to see product sales by region, drilling down from a bar chart to a grouped bar chart. Such incremental construction of visualizations is regularly performed in tools such as Excel, Tableau, and Spotfire.

The visualization challenge posed by each of these examples is to keep the readers of data graphics oriented during transitions. Ideally, viewers would accurately identify elements across disparate graphics and understand the relationship between the current and previous views. This is particularly important in collaborative settings such as presentations, where viewers not interacting with the data are at a disadvantage to predict the results of transitions.

Animation is one promising approach to facilitating perception of changes when transitioning between related data graphics. Previous

applied to direct attention to points of interest. Second, animation facilitates object constancy for changing objects [17, 20], including changes of position, size, shape, and color, and thus provides a natural way of conveying transformations of an object. Third, animated behaviors can give rise to perceptions of causality and intentionality [16], communicating cause-and-effect relationships and establishing narrative. Fourth, animation can be emotionally engaging [24, 25], engendering increased interest or enjoyment.

However, each of the above features can prove more harmful than helpful. Animation's ability to grab attention can be a powerful force for distraction. Object constancy can be abused if an object is transformed into a completely unrelated object, establishing a false relation. Similarly, incorrect interpretations of causality may mislead more than inform. Engagement may facilitate interest, but can be used to make misleading information more attractive or may be frivolous—a form of temporal "chart junk" [23]. Additionally, animation is ephemeral, complicating comparison of items in flux.



Animation Caveats

Changes can be hard to track

Eyes over memory!

- Show all states in multiple views

Navigation

Navigation

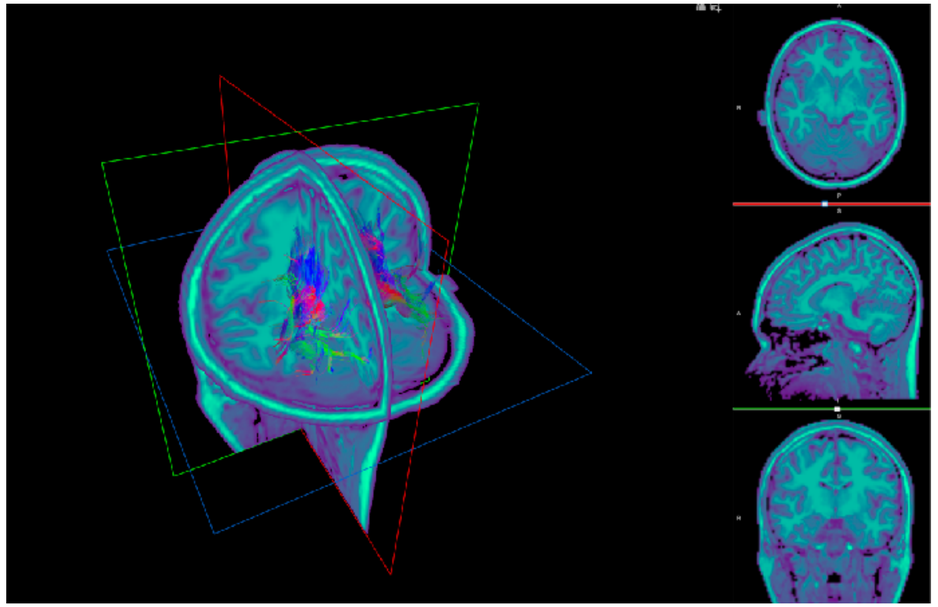
Pan

move around

Zoom

enlarge/ make smaller (move camera)

Rotate



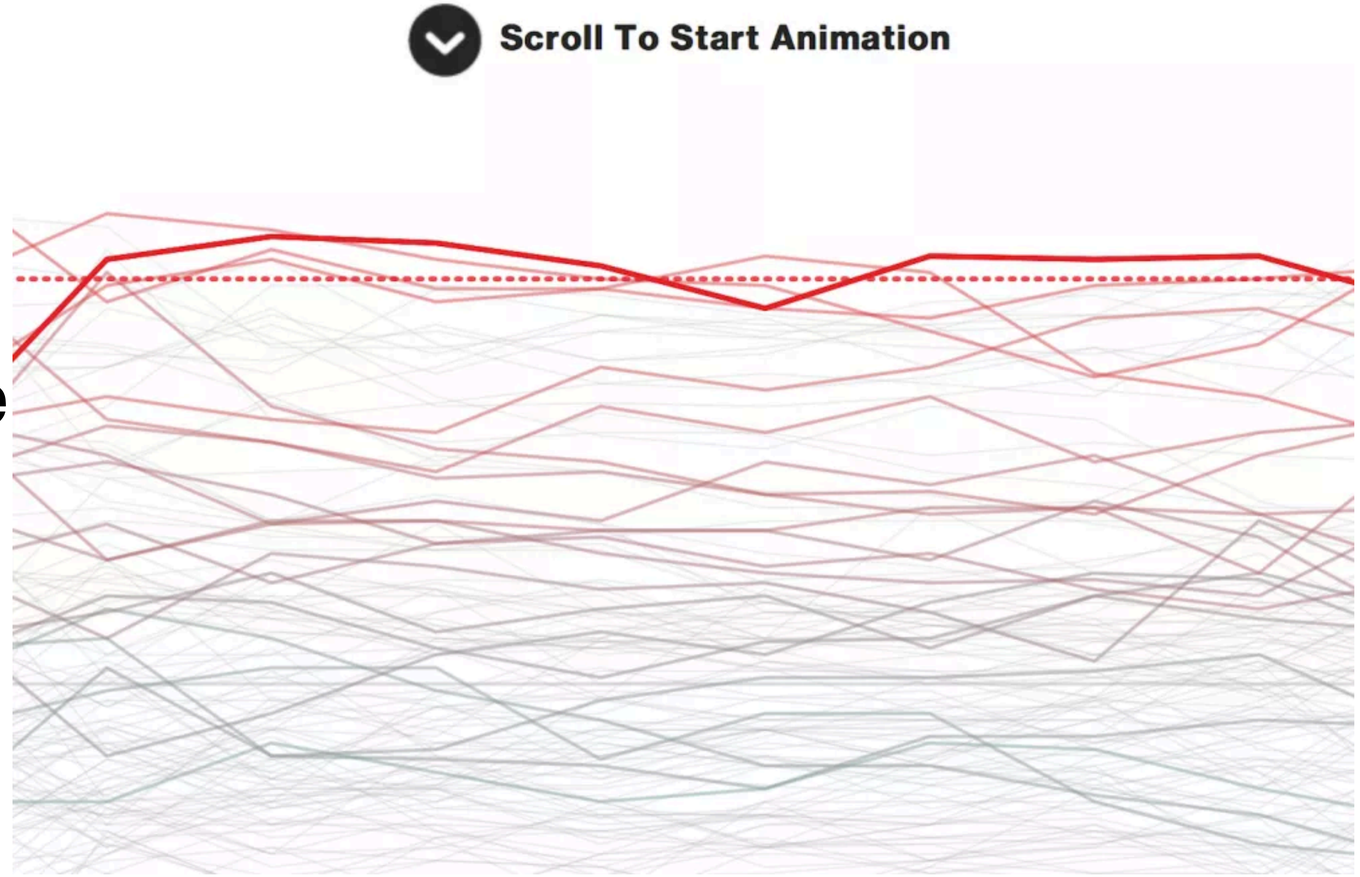
Scrollytelling

Telling an interactive story

Interaction by scrolling

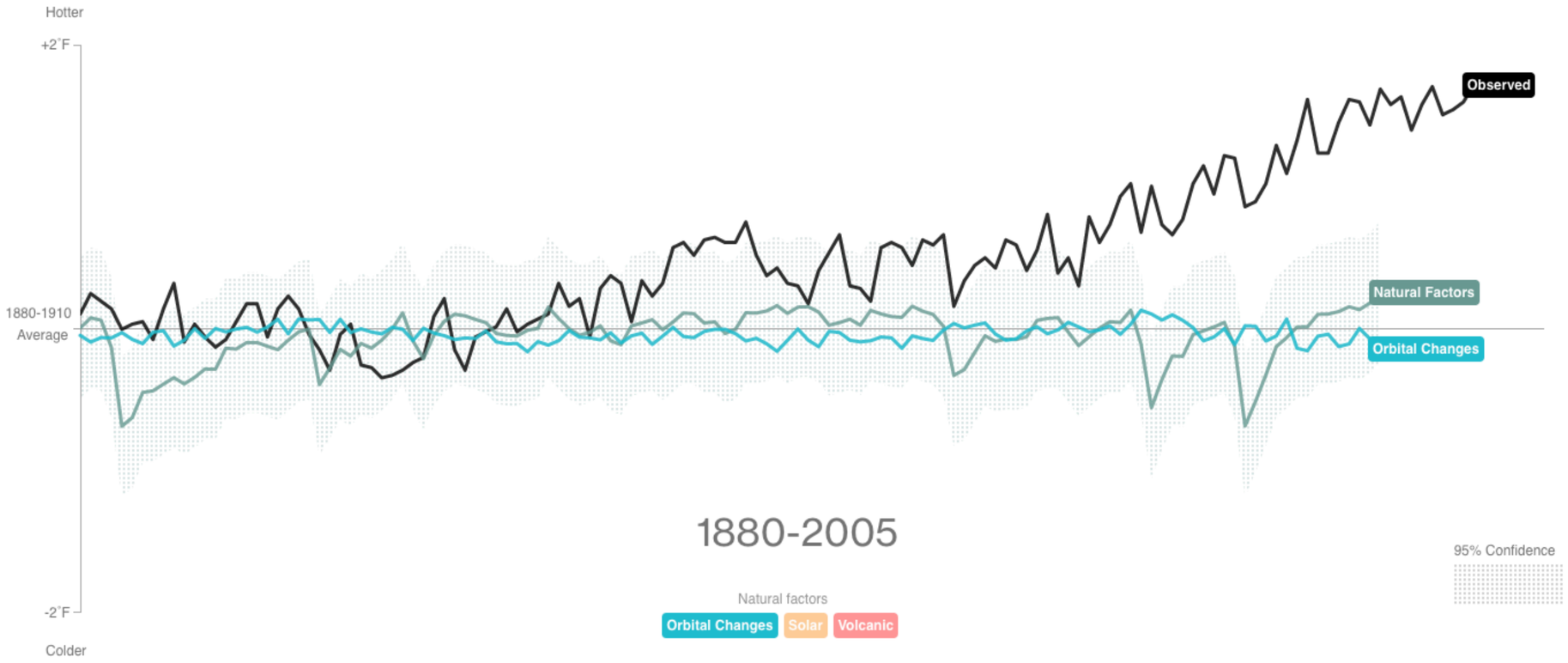
Nice but

- Continuous scrolling vs discrete states
- Direct access
- Unexpected behavior



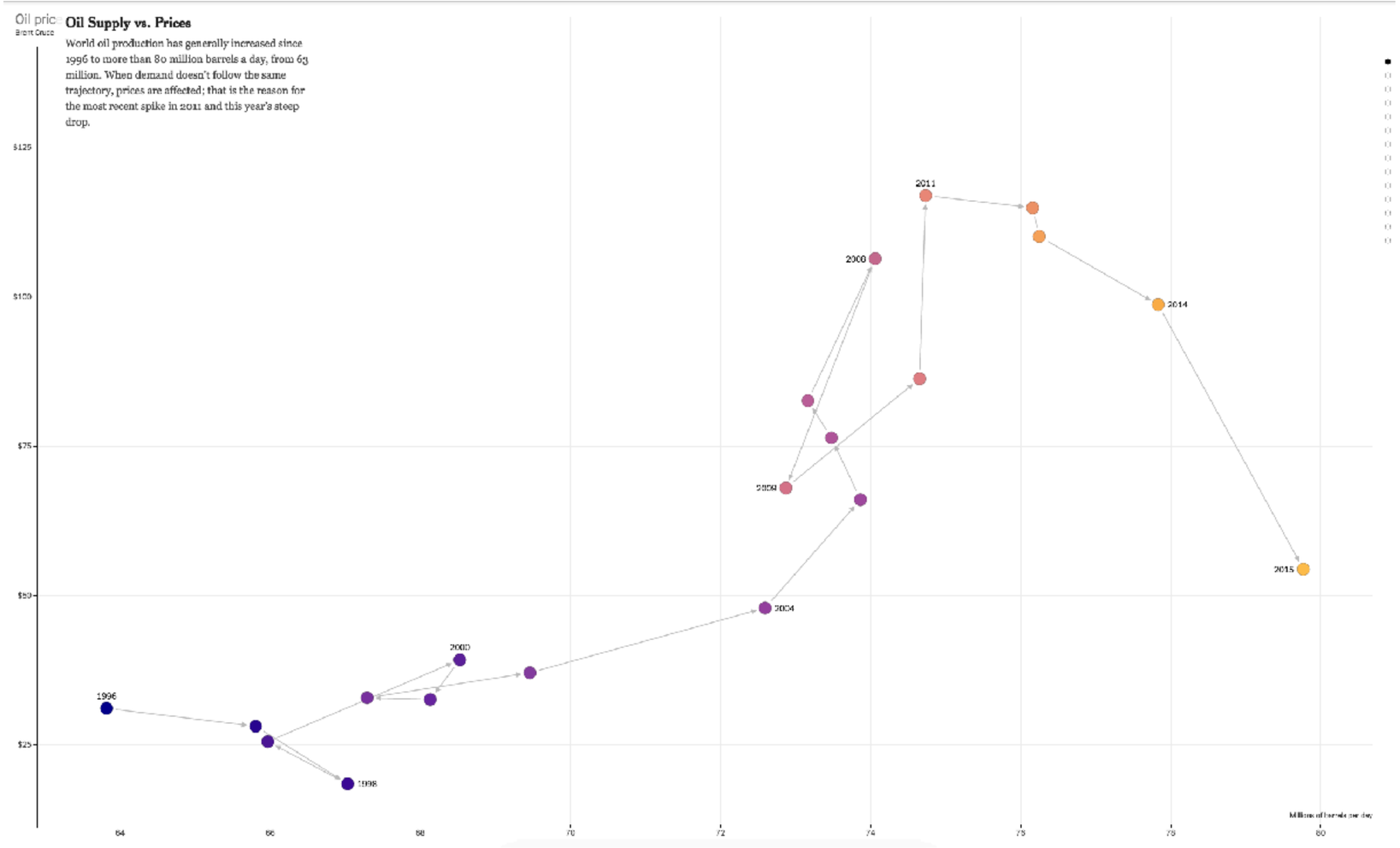
https://eagereyes.org/blog/2016/the-scrollytelling-scourge

Example: What's Warming the World



www.bloomberg.com/graphics/2015-whats-warming-the-world/

Example: Oil Prices



http://www.nytimes.com/interactive/2015/09/30/business/how-the-us-and-opec-drive-oil-prices.html?_r=0

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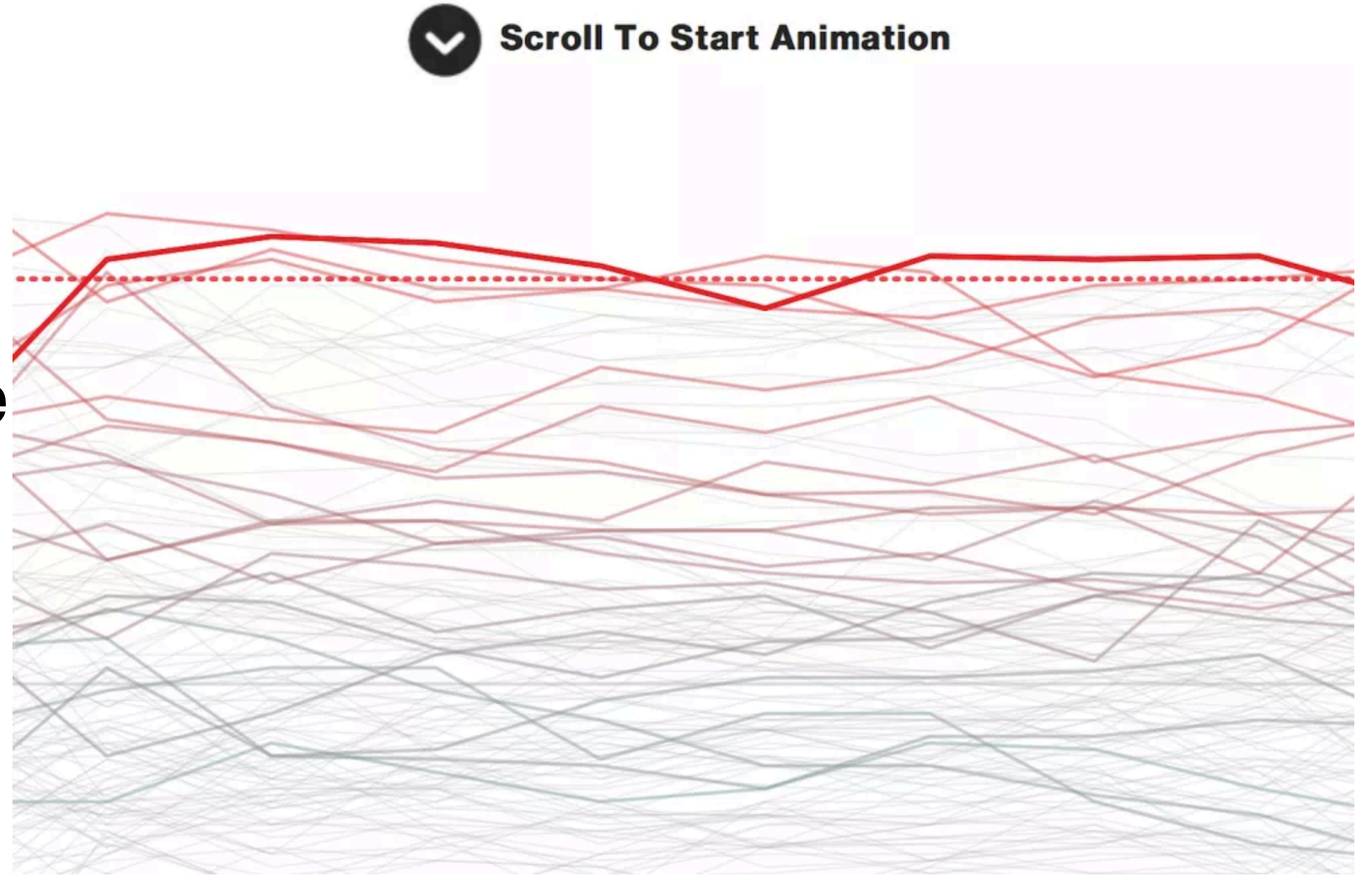
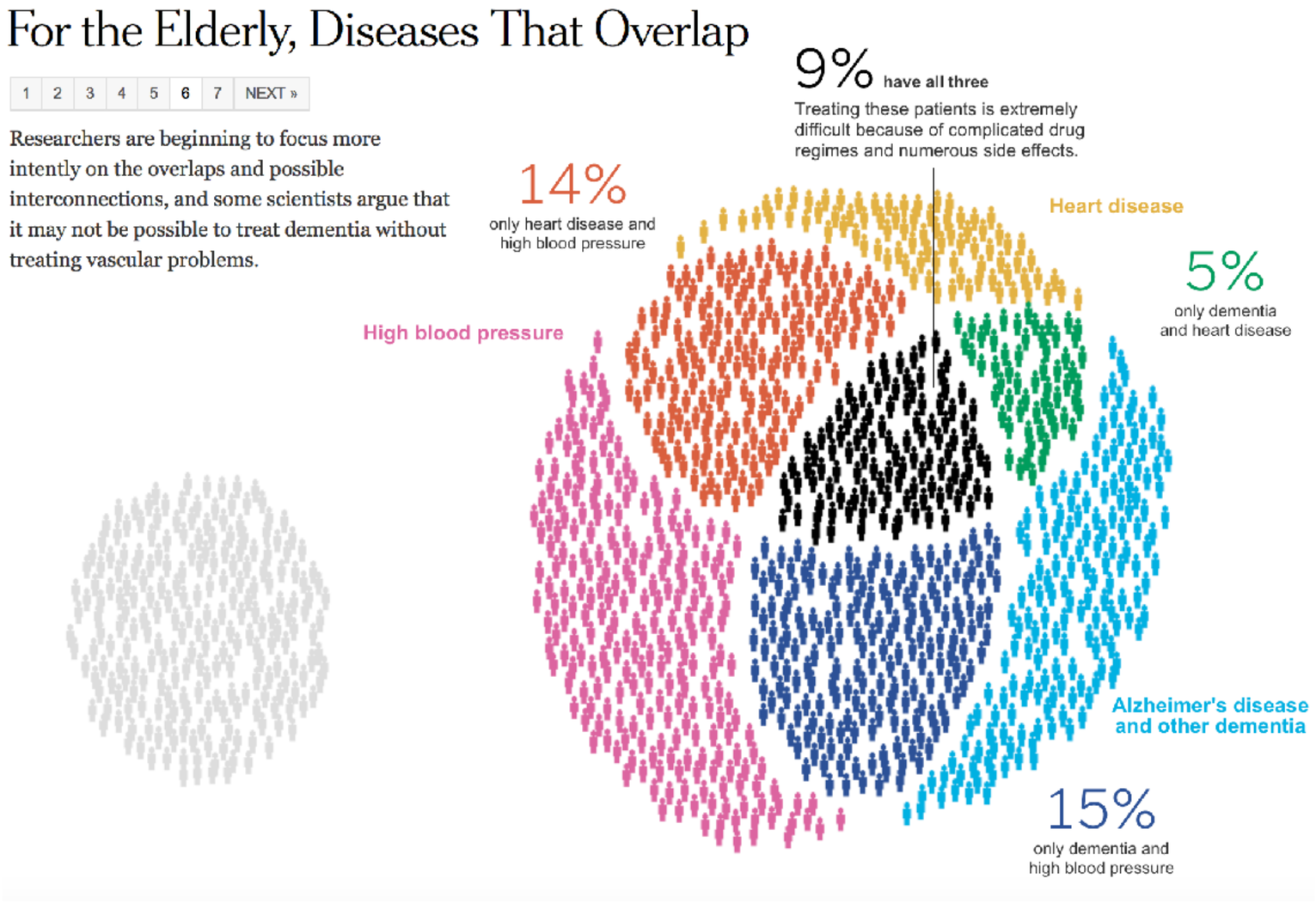


https://eagereyes.org/blog/2016/the-scrollytelling-scourge

Alternative: Stepper



Semantic Zooming

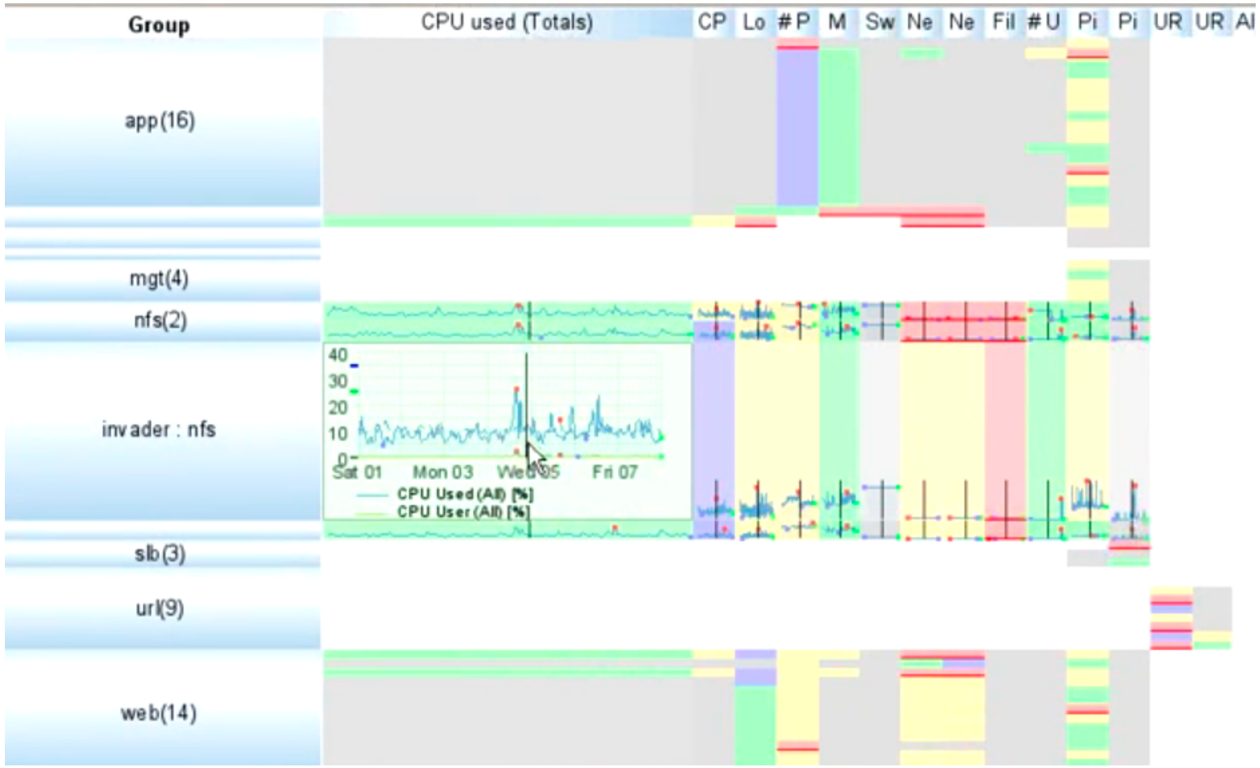
Semantic Zoom

Semantic Zooming

As you zoom in, content is updated

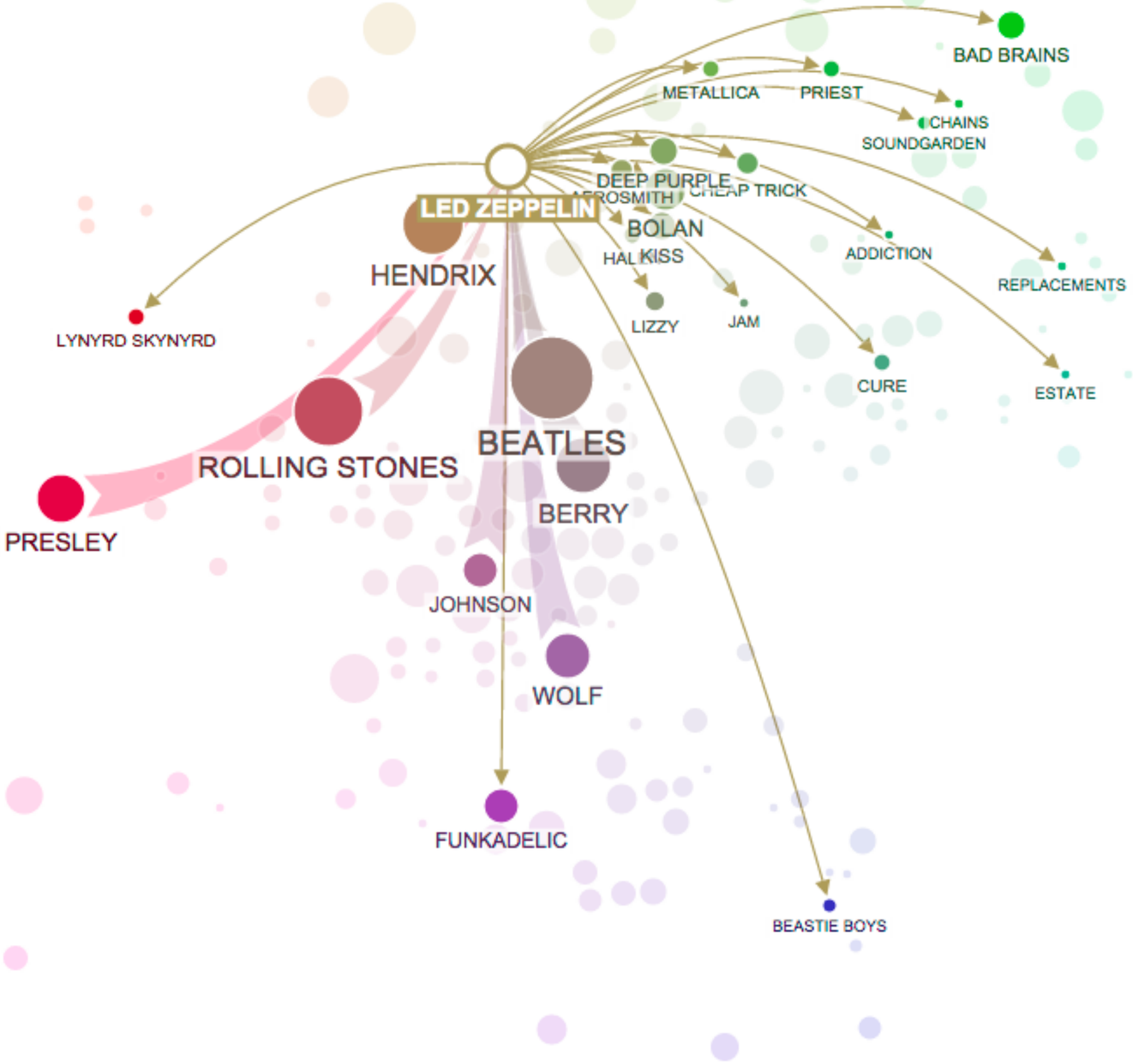
More detail as more space becomes available

Ideally readable at multiple resolutions



[McLachlan 2008]

Design Critique



In your breakout group, discuss the following questions:

- What is the data shown? How could this data be acquired?
- How is each data type visually encoded?
- Is the data plotted directly or is it abstracted?
- How is interaction used? Why is interaction used?
- Compare the timeline view to the similarity view. Which tasks do these views address?
- In the timeline view, do you notice something about the scales? What and why?
- Why do you like / dislike this visualization?

http://bit.ly/edge-maps

Focus + Context

Focus + Context

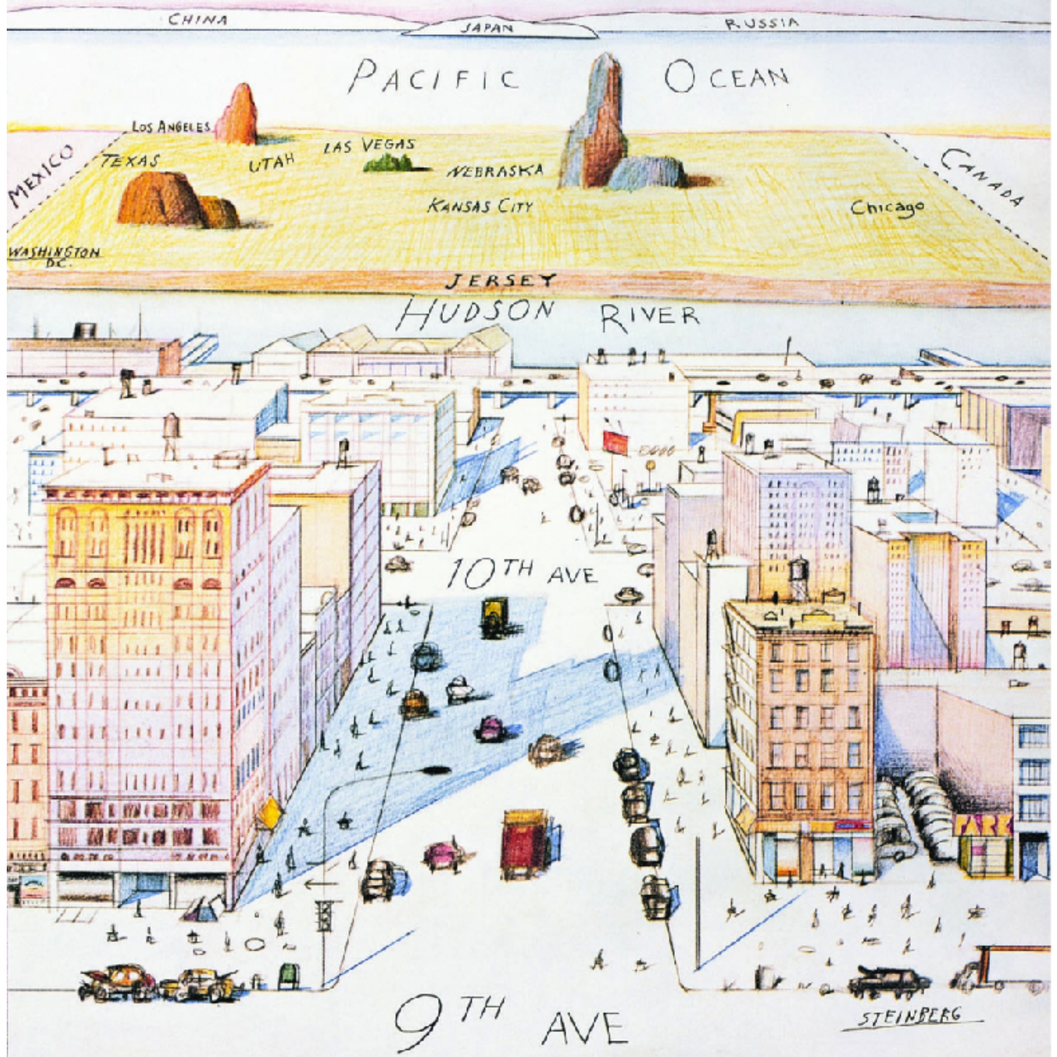
carefully pick what to show

hint at what you are not showing

Mar. 29, 1976

THE NEW YORKER

Price 75 cents



Focus + Context

synthesis of **visual encoding and interaction**

user selects region of interest (focus)
through navigation or selection

provide context through

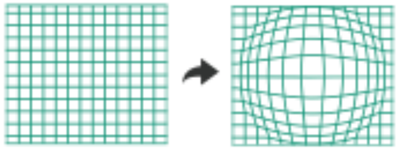
- aggregation
- reduction
- layering

Embed

- Elide Data

- Superimpose Layer

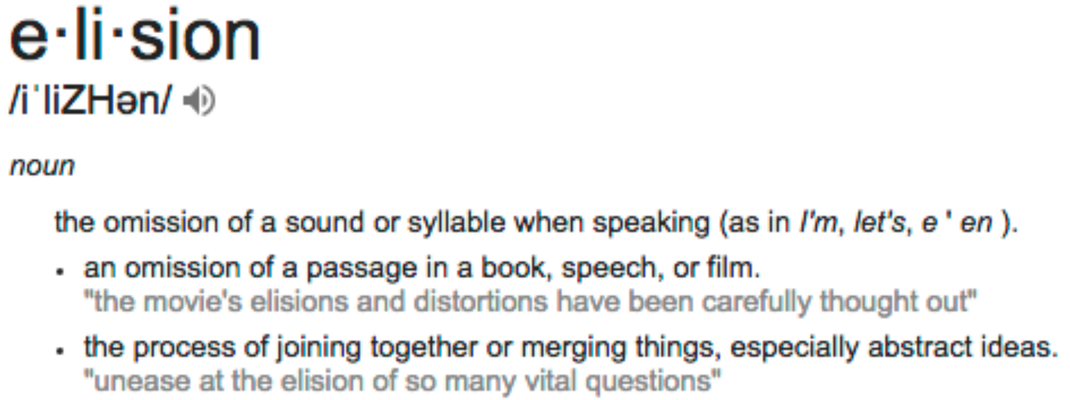
- Distort Geometry



Elision

focus items shown in detail,

other items summarized for context



e·li·sion

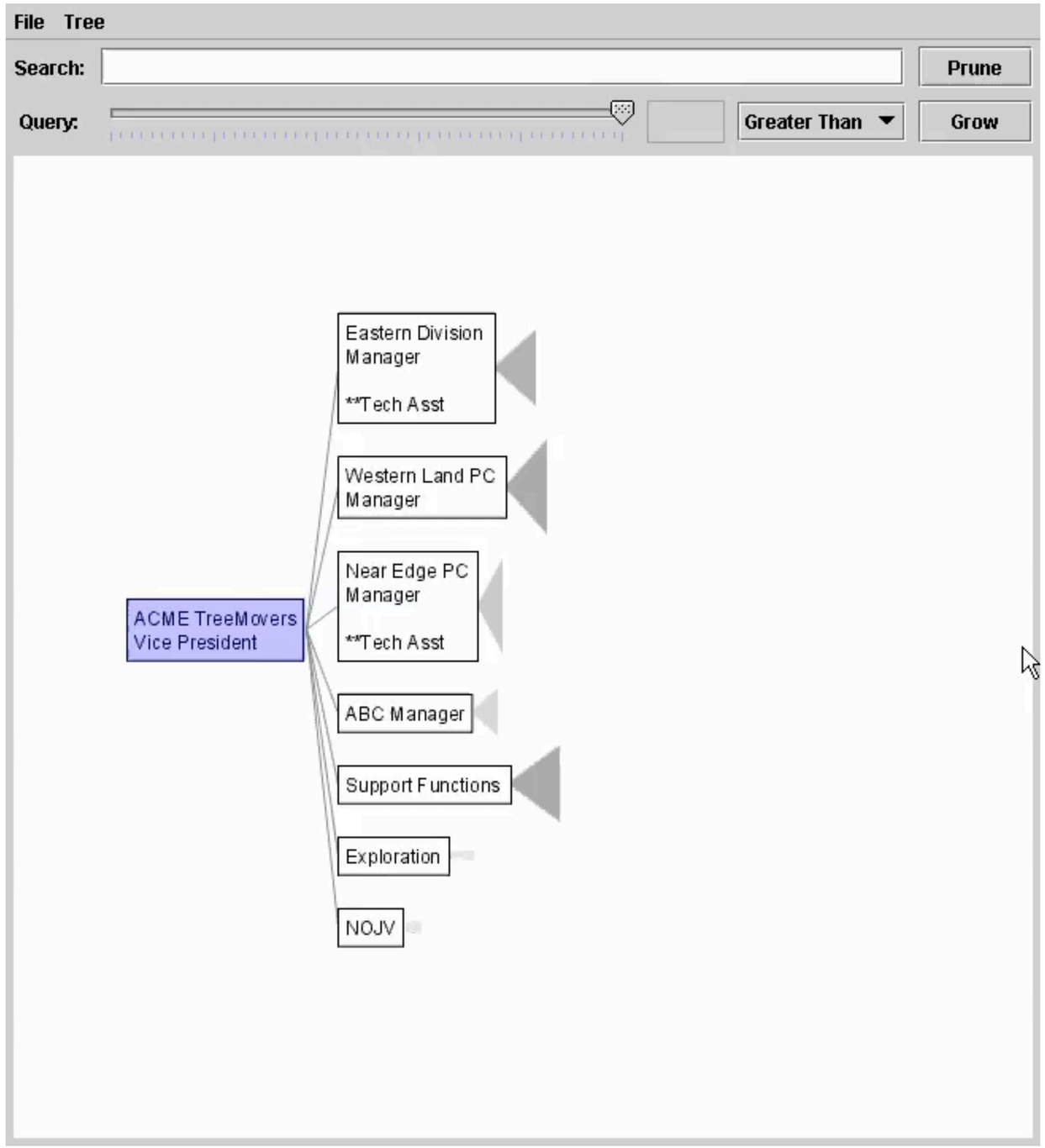
/iˈliZHən/

noun

the omission of a sound or syllable when speaking (as in *I'm*, *let's*, *e ' en*).

- an omission of a passage in a book, speech, or film.
  "the movie's elisions and distortions have been carefully thought out"
- the process of joining together or merging things, especially abstract ideas.
  "unease at the elision of so many vital questions"

SpaceTree



Grosjean 2002

Degree of Interest (DOI)

Based on observation that humans often represent their own neighborhood in detail, yet only major landmarks far away

Goal is balance between local detail and global context

$$DOI(x) = I(x) - D(x,y)$$

I - interest function
D - a distance function, either semantic or spatial

x- the location of an item

y - current focus point

Furnas 1986

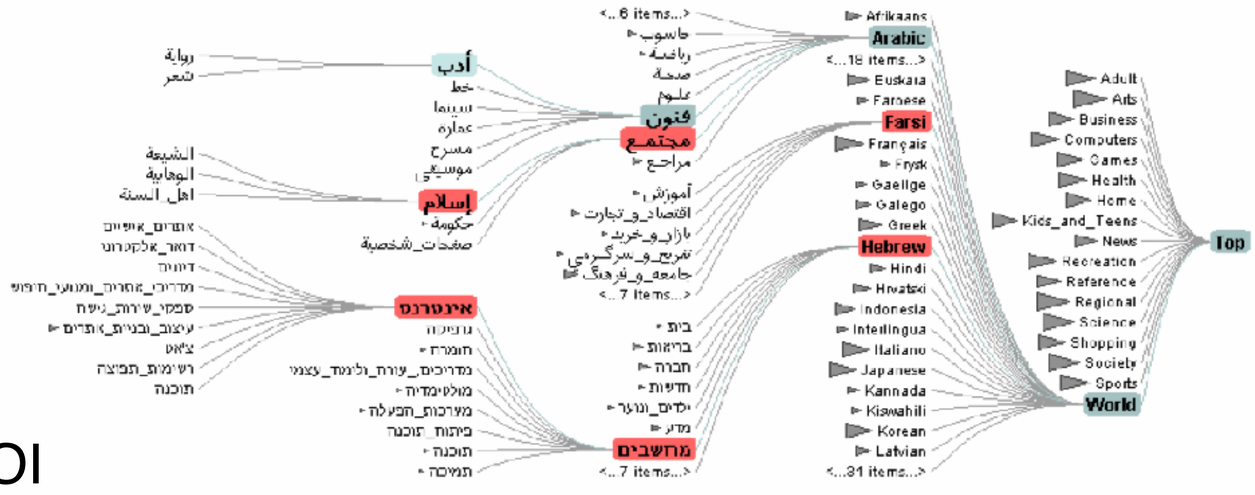
DOI Tree

interactive trees with animated transitions that fit within a bounded region of space

layout depends on the user's estimated DOI

uses:

- logical filtering based on DOI
- geometric distortion of node size based on DOI
- semantic zooming on content based on node size
- aggregate representations of elided subtrees



[Heer 2004]